

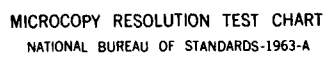
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
CRESCENT STREET DAM M. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV JUN 79

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CONNECTICUT RIVER BASIN
ATHOL, MASSACHUSETTS

CRESCENT STREET DAM
MA 00934

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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JUL 03 1985
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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JUNE 1979

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER MA 00934	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Crescent Street Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE June 1979
		13. NUMBER OF PAGES 75
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		16a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Connecticut River Basin Athol Massachusetts Millers River		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam is about 127 ft. long and 28 ft. high. It is considered in fair condition primarily because of its somewhat limited spillway capacity and vibration of the bascule gate. It is small in size with a high hazard potential. Investigations are recommended to determine the hydraulic adequacy of the spillway and a method of minimizing vibrations in the bascule gate.		

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED

NOV 13 1979

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Inclosed is a copy of the Crescent Street Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, L.S. Starrett Co., Athol, Massachusetts 01331.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely,

Max B. Scheider
MAX B. SCHEIDER

Colonel, Corps of Engineers
Division Engineer

Incl
As stated

CONNECTICUT RIVER BASIN
ATHOL, MASSACHUSETTS

CRESCENT STREET DAM
MA 00934

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JUNE 1979

CRESCENT STREET DAM
MA 00934

CONNECTICUT RIVER BASIN
ATHOL, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

**PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM**

Identification No. : MA 00934
Name of Dam: CRESCENT STREET DAM
Town: ATHOL
County and State: WORCESTER, MA
Stream: MILLERS RIVER
Date of Inspection: 15 NOVEMBER 1978

BRIEF ASSESSMENT

Crescent Street Dam is approximately 127 feet long and 28 feet high. The major portion of the dam is a concrete weir with a 98 foot long bascule gate at its crest. An intake and overflow weir are located at the left abutment and a second intake is present upstream of the right abutment. The dam was originally constructed in 1906 and substantially modified in 1939 for the installation of the bascule gate. The dam provides water for power generation at the adjacent mills.

The dam is considered in fair condition primarily because of its somewhat limited spillway capacity and vibration of the bascule gate. While vibration of the gate is not normally a dam safety condition, continued vibration can cause acceleration of cracking in the concrete as well as fatigue failure of the gate itself. Settlement of fill behind the right abutment is indicated by the cracking parallel to the river in the structures at this area. The facility does appear to be well maintained by the owner.

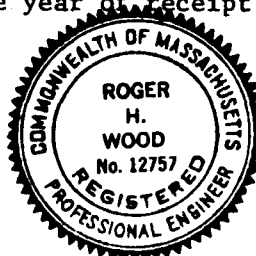
Based on the size classification, small, and hazard classification, high, in accordance with the Corps of Engineers guidelines, the spillway test flood selected is one-half the Probable Maximum Flood ($\frac{1}{2}$ PMF). Hydraulic analysis indicates the peak test flood outflow would be 26,900 cfs while the spillway capacity with water surface at the crest of the dam is estimated to be 14,400 cfs (54 percent of the test flood peak outflow). The test flood selected would result in an overtopping of the dam in excess of 4.7 feet at peak discharge at which time 96 percent of the flow would be passing over the concrete dam.

Investigations are recommended to determine the hydraulic adequacy of the spillway and a method of minimizing vibrations in the bascule gate. Recommended remedial measures include the monitoring of the cracks at the right abutment to determine if active settlement or subsidence is taking place, the repair of concrete at both water intakes, the removal of debris and repair of cracks in the inspection gallery and the compiling of maintenance procedures into a ready reference. It is also recommended that the dam be kept under observation during periods of high precipitation, a program of annual technical inspections be instituted, and a warning system and emergency preparedness plan be developed. The investigations and remedial measures should be performed within one year of receipt of the report by the Owner.

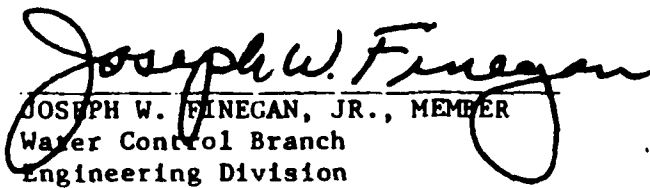
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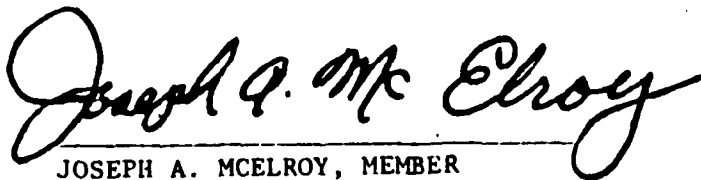
Roger H. Wood

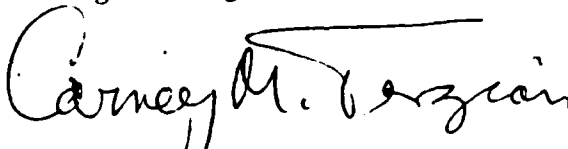
Roger H. Wood
Vice President



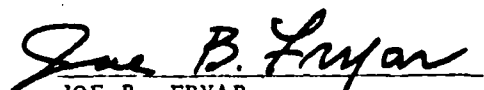
This Phase I Inspection Report on Crescent Street Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.


JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division


JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division


CARNEY M. TERZIAN, CHAIRMAN
Chief, Structural Section
Design Branch
Engineering Division

APPROVAL RECOMMENDED:


JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm runoff), or a fraction thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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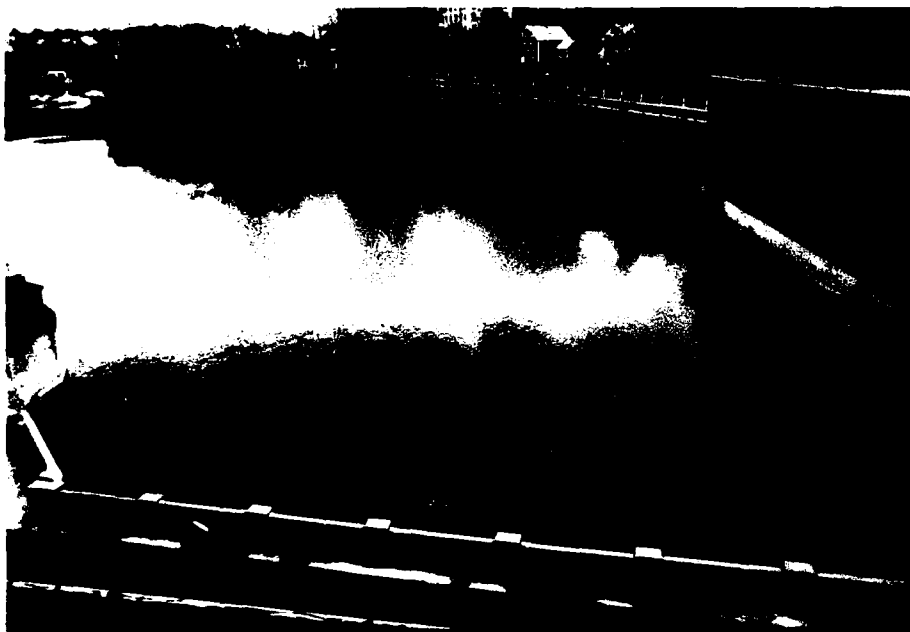
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1. OVERVIEW OF DAM FROM ROOF OF BUILDING WHICH SPANS DOWNSTREAM CHANNEL. RAILING OF ROADWAY BRIDGE IN FOREGROUND.

The values of the flows at the dam site would be between the recorded flows for the two stations and much closer to the values shown for the South Royalston Station. The table above indicates that the magnitude of the flood flows at the gaging stations have been reduced significantly since the construction of the Birch Hill Reservoir in 1941. The floods which caused major damages occurred in March 1936 and in September 1938. The following historical data were taken from 1936 and 1938 flood reports by the Massachusetts Geodetic Survey.

In March 1936, the old steel truss bridge on Crescent Street was overtopped by 7.4 feet of water; ice jams damaged the bridge, abutments and roadway, and the bridge collapsed; the water depth at the spillway was about 10 feet. The stone arched bridge on Main Street was overtopped by about 1.6 feet of water at the centerline of the road and although no damage occurred to the bridge, the nearby property was flooded.

In September 1938, the new bridge surface on the Crescent Street was subject to flooding by about 3.0 feet of water with no damage to the bridge; the water depth at the spillway was about 12.5 feet; 100 feet of the north approach of the Exchange Street bridge was washed away to the bed of the river and the bridge rails were badly damaged by debris; Exchange Street was flooded for a distance of 456 feet south of and 362 feet north of the bridge (this bridge appears to have been reconstructed afterwards, at a higher elevation).

A study of flood records from the three gaging stations on the Millers River indicates a distinct relationship between the peak discharge in cfs per sq. mi. (csm) and the drainage area for these three gaging stations for the March, 1936 and September, 1938 floods as follows:

PEAK DISCHARGE FOR TWO GREATEST FLOODS

Gaging Station	Drainage Area (sq. mi.)	March, 1936		September, 1938	
		(cfs)	(csm)	(cfs)	(csm)
1. Millers River at Winchendon, MA	83.8	5,530	66.0	8,500	101.4
2. Millers River at S. Royalston, MA	187	---	---	15,000*	80.2
3. Millers River at Erving, MA	375	19,700	52.5	29,000	77.3

*Estimated from observed high water mark and subsequently developed stage-discharge relationship.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

- a. General - The masonry dam was originally constructed in 1909, and the float controlled bascule gate was installed on the crest in 1939. The main purpose of the dam is power generation for the L.S. Starrett Company Mill. The surcharge-storage capacity of the pond is relatively small; therefore, any excess flow into the reservoir spills over the crest. The water level in the pond is regulated automatically with a float valve up to 3 feet, to the full height of the gate.
- b. Design Data - No hydrologic or hydraulic design data are available for this dam site.
- c. Experience Data - The U.S. Geological Survey has maintained and published records of 3 stream gaging stations on the Millers River. One of these stations, with water stage recorder, is located in South Royalston, about 7.4 miles upstream of the Crescent Street dam; another one is located in Erving, about 12.6 miles downstream of the dam site. The third is located about 14.7 miles upstream of Crescent Street dam in Winchendon. The stage-discharge relationships at all three of the stations have been established by current-meter measurements. The recorded maximum flows at the two nearest stations are presented below:

	<u>Millers River at South Royalston</u>		<u>Millers River at Erving</u>	
Drainage Area:	187 sq. mi.		375 sq. mi.	
Elevation (NGVD):	792		380	
<u>Date</u>	<u>Flow(cfs)</u>	<u>Gage Ht(ft)</u>	<u>Flow(cfs)</u>	<u>Gage Ht(cfs)</u>
Sept. 21 or 22, 1938	?	15.90	29,000	13.37
April 13, 1940	4,400	8.40	7,000	5.10
June 25,26, 1944	2,830	7.57	4,890	7.51
April 5-7, 1960	2,280	7.41	5,020	6.91
March 16, 1977	2,370	7.40	5,640	7.05

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Although there is a routine for the operation of the dam, there is no written procedure. The moveable weir crest, the bascule gate, is automatically controlled from a float well.

4.2 Maintenance of Dam

It appears that there has been systematic maintenance of the dam.

4.3 Maintenance of Operating Facilities

The maintenance of the operating facilities is performed on a routine basis. The bascule crest gate has a 3 foot range and is automatically operated by means of a float control. Once a year, the pond level is lowered and the gate and side plates are cleaned and painted. At the same time the side plates and torque tube is greased to prevent "J" seal wear and rupture. Once each month the gate is manually operated and the accumulator, compressor, and pump are checked. The water wheel and pond drain cast iron sluice gates are operated a minimum of once a year. The hand cranked rack and pinion operators are maintained in good operating condition.

4.4 Description of any Warning System in Effect

There is no formal established warning system or emergency preparedness plan in effect for this structure.

4.5 Evaluation

The dam is currently being operated on a routine basis. The procedures being employed should be compiled in writing and expanded where necessary for ready reference by the operating personnel. It should also contain provisions for the observation of the dam during periods of high precipitation, the annual technical inspection of the dam, an emergency preparedness plan and the details of operation of a warning system.

- 3.2 Evaluation - Except for the probable settlement in the right abutment area, vibration of the raised bascule gate, and the minor maintenance items noted in the visual examination, Crescent Street Dam appears to be well maintained and in good condition. The gradual settlement of the area behind the right abutment wall does not appear to offer significant potential for dam failure at this time.

Starrett plant engineering personnel have advised that the condition first became evident about 10 years ago, and has been watched since then. The cracking has progressed slowly. It is reported that there may have been an increase in the rate about 4 years ago, and a decrease since then, although there is no record of actual crack measurements. Starrett personnel have not seen evidence of soil loss from the filled area.

- c. Appurtenant Structures - The gatehouse is in good condition and, with the exception of the previously mentioned crack through the structure, no deficiencies were noted.

The observable portions of the upstream intake on the right side of the river are in good condition. There is a crack in the concrete at the upstream exterior corner and spalling of the concrete is occurring near the water surface of the same area.

The observable portions of the intake and overflow weir at the left abutment are also in good condition. The concrete veneer over the stone masonry at the downstream end of the weir has started to spall and minor vegetation is present in the deteriorated area as shown in Photos 9 and 12.

- d. Reservoir Area - There is approximately a 1/2 mile reach of river between Crescent Street Dam and the next upstream dam. This reach, which serves as the upstream pool, has a forested, moderately sloped right bank and a steeply sloped highway embankment on the left bank. The mill and associated parking lots located adjacent to the upstream dam may be affected by the river surcharge at test flood elevation.

No significant potential was observed for landslides into the general pool area of the dam which could create waves that might overtop the abutments of the dam. No conditions were noted that would result in a sudden increase in sediment load into the upstream pool.

- e. Downstream Channel - The Millers River joins the Connecticut River at a distance of about 18 miles downstream from the Crescent Street dam. The channel is about 70 feet wide and about 145 feet wide at the Exchange Street bridge. The average gradient of the channel, as estimated from the USGS Athol quadrangle, varies from 0.31% near the Crescent Street bridge to 0.44% at the Exchange Street bridge. Downstream of Exchange Street the channel gradient flattens considerably to less than 0.06% with an even flatter gradient (0.03%) in the next 5 miles of river. Ledge outcrops and boulders in various sizes were observed in the channel. The left and right banks of the channel are protected with concrete walls of the manufacturing plants. Small trees were noted to be growing from soil deposits along the sides of the stream channel. Four important crossings exist within 2 miles downstream from the dam: The Crescent Street bridge is adjacent to the dam, Exchange Street bridge 1/3 of a mile downstream, Main Street bridge one mile downstream and Boston & Maine railroad bridge 2 miles downstream.

SECTION 3: VISUAL INSPECTION

3.1 Findings

- a. General - The Phase I Visual Examination of the Crescent Street Dam was conducted on 15 November 1978.

In general, the dam was observed to be in good condition, but the bascule gate does vibrate in the raised position. The pool level at the time of the site examination was several inches above the weir crest with the bascule gate in the raised position.

Visual inspection checklists for the site visit are included in Appendix A and selected photographs are given in Appendix C.

- b. Dam - The Crescent Street Dam is generally in good condition. There was no observed evidence of significant seepage, lateral movement or significant erosion. The structures at the right abutment, as shown in Photo 11, do exhibit a crack parallel to the river indicating probable settlement of the fill in this area.

The bascule gate was manually operated during the inspection as shown in Photos 1, 2, 3 and 8, exposing the downstream face of the dam when the gate was returned to its raised position. The concrete weir appeared to be in good condition and no pressure leaks were observed. Some minor leakage was present under the gate and the gate does vibrate when in its raised position. The inspection and pipe gallery within the dam as shown in Photo 6 has debris on the floor, efflorescence on the walls, a vertical crack at the right abutment and a longitudinal crack at the spring line of the arched roof. Rust, staining and seepage are present at the cracks.

While the dam has no obvious embankment, the filled area between the discharge channels, and the materials behind the left abutment and to the right of the turbine and drain space, also serve to retain the water stored behind the dam. The far left and right areas under the building floors are apparently in good condition, but there has been cracking and differential settlement of the concrete slab-on-grade behind the right abutment wall, apparently due to settlement of fill behind the wall. Diagonal cracking in the brick gatehouse wall and cracking in the concrete foundation and divider walls, as mentioned above and shown in Photo 11, are also indicative of settlement of the surface of the underlying embankment.

SECTION 2: ENGINEERING DATA

2.1 Design Records

There are no known design records for the original dam as constructed in 1906. Plans of the 1939 modification to the dam were located.

2.2 Construction Records

No records of the original construction were located.

2.3 Operation Records

No operational records other than State inspection reports are available for the dam.

2.4 Evaluation

- a. Availability - Documents described above are generally available at the offices of Charles T. Main, Consulting Engineers, Boston, Massachusetts. These documents are in storage and may require time to make them readily available. Some of the documents are also available at the Office of the County Engineer, Worcester County Courthouse, Worcester, Massachusetts.
- b. Validity - The drawings for this project were in agreement with the features observed in the field.
- c. Adequacy - The available data, in combination with the visual inspection described in the following section, is adequate for the purposes of the Phase I Investigation.

- (4) Top width-----11 ft. (Approx.)
- (5) Side slopes-----U/S vert
D/S 1H/2V
- (6) Zoning-----Abutments unknown
- (7) Impervious Core-----Abutments unknown
- (8) Cutoff-----Probably stone masonry wall at abutments
- (9) Grout Curtain-----Probably none
- h. Diversion and Regulating Tunnel-----N/A
- i. Spillway
 - (1) Type-----Concrete gravity weir with bascule gate
 - (2) Length of weir-----98 ft. +
 - (3) Crest elevation----- (gate lowered)-538.3
 (gate raised)--541.3
 - (4) Gates-----3 ft. high by 98 ft. long bascule
 - (5) U/S Channel-----Millers River
 - (6) D/S Channel-----71.5 ft. wide and 18 ft. deep (at
Crescent Street Bridge); 0.0031 gradient
- j. Regulating Outlets - The primary regulating device at this dam is the bascule gate described in paragraph i above. The gate is automatically controlled by a float valve to facilitate the passage flooding events. In addition to the gate, there are outlets on each side of the upstream channel. On the right side there are two seven foot diameter penstocks controlled by gates. On the left side of the channel, there is a 6 foot diameter inlet to a turbine. The elevation of the outlet pipes is unknown.

- (5) Full flood control pool-----N/A
- (6) Spillway crest-----gate lowered--538.3
gate raised---541.3
- (7) Design surcharge (Original Design)-----Unknown
- (8) Top of dam-----549.3
- (9) Test flood design surcharge-----approximately--554

d. Reservoir

- (1) Length of test flood pool-----0.3 mi. (Est.)
- (2) Length of normal pool-----0.2 mi. (Est.)
- (3) Length of flood control pool-----N/A

e. Storage (acre-feet)

- (1) Normal pool-----35
- (2) Flood control pool-----N/A
- (3) Spillway crest pool (gate lowered)-----22
- (4) Top of dam-----87
- (5) Test flood pool-----135 (Est.)

f. Reservoir Surface (acres)

- (1) Normal pool-----4.6
- (2) Flood-control pool-----N/A
- (3) Spillway crest (gate lowered)-----3.6
- (4) Test flood pool-----8.0+
- (5) Top of dam-----7.8

g. Dam

- (1) Type-----Main portion--concrete gravity weir with
basculer gate
- (2) Length-----Main portion 98 ft; Total 127 ft.+
- (3) Height-----28 ft. (Est.)

- a. Drainage Area - The Crescent Street Dam in Athol is located on the Millers River, a tributary to the Connecticut River. The watershed above the dam is about 201 square miles. The length of the main stream within the watershed is about 30 miles of which 8 miles is in the State of New Hampshire. Elevations along the watershed boundary rise from about 600 feet near the dam to about 1,850 feet at the Wapack range in the northeastern fringes of the basin. The basin contains several lakes and reservoirs which are effective in regulation of the stream flows. The most significant of these is the Corps of Engineers' Birch Hill Dam and Reservoir on the Millers River, some 8 miles upstream of South Royalston. The dam is located downstream of the confluence of the Millers River, Otter River, Priest Brook and Tarbell Brook and controls runoff from a drainage area of 175 sq. mi. with a usable storage capacity of 49,900 acre-ft. at spillway crest Elev. 852.0.
- b. Discharge at Dam Site - There are no quantitative records of discharges at the dam site. The two greatest floods at the location occurred in March 1936 and September 1938. Estimated discharges based on records of upstream and downstream gaging stations and recorded high water elevations are 11,000 cfs and 16,000 cfs, respectively. These floods occurred prior to the installation of the bascule gate when the fixed spillway crest was essentially at the same elevation as the top of the present bascule gate in the raised position.
 - (1) Outlet works size: 6 ft. diameter left abutment. 2-7 ft. diameter right abutment.
 - (2) Maximum known flood at damsite: 16,000 cfs (Est.)
 - (3) Ungated spillway capacity at top of dam: 14,400 cfs at elevation 549.3
 - (4) Ungated spillway capacity at test flood elevation: 25,950 cfs at approximate elevation 554
 - (5) Gated spillway capacity at normal pool elevation: 2,870 cfs at elevation 542.5
 - (6) Gated spillway capacity at test flood elevation: 20,850 cfs at approximate elevation 554
 - (7) Total spillway capacity at test flood elevation: 25,950 cfs at approximate elevation 554
 - (8) Total project discharge at test flood elevation: 26,900 cfs at approximate elevation 554
- c. Elevation (NGVD)
 - (1) Streambed at centerline of dam-----521.1
 - (2) Test flood tailwater-----539.0
 - (3) Upstream portal invert diversion tunnel-----N/A
 - (4) Normal pool-----541.3

- d. Hazard Classification - Based on the dam failure analysis, the dam is classified in the "high" hazard category. The dam failure has been assumed to be caused by a massive fracture involving 80 percent of the 98 ft. spillway length with the water level at Elev. 553.8 (Sept. 1938 flood). The downstream channel would be subject to an estimated flood flow of 24,300 cfs, which is in excess of the estimated capacity of the channel. This flood flow would be 50% in excess of the estimated flow of 16,000 cfs for the greatest flood of record, that of September, 1938. This flood flow was responsible for heavy damage to the Exchange Street Bridge 1,600 feet downstream, while the March, 1936 flood (11,000 cfs) caused the failure of the Crescent Street Bridge. A failure of the dam under these assumed conditions would probably place the Crescent Street Bridge and the mill building spanning the river downstream of Crescent Street in jeopardy, and causing a potential for loss of more than a few lives.
- e. Ownership - The dam is owned by the L.S. Starrett Company. The owner is represented by Mr. R.W. Trenoweth, Works Manager, 121 Crescent Street, Athol, Massachusetts 01331 (phone: (617) 249-3551).
- f. Operator - Mr. William D. Thorp, Plant Engineer, is assigned responsibility for operation of the dam. His address is 121 Crescent Street, Athol, Massachusetts 01331 (phone: (617) 249-3551).
- g. Purpose of the Dam - The dam serves to control Starrett Mill Pond which is used by the L.S. Starrett Company for power generation.
- h. Design and Construction History - There are indications that a timber dam was originally constructed at this location. The stone masonry intake upstream of the right abutment was constructed in approximately 1900. The intake at the left abutment was either in existence prior to that time or constructed at the same time. The basic dam as it exists today was designed and constructed of concrete in 1906 by the George N. Cutting Company of Worcester, Massachusetts.

The crest of the dam was removed and a new concrete upstream face and crest were added in 1939. The new concrete crest served as the base for a bascule gate installed on the spillway at the same time. The design engineers for the 1939 modification was Charles T. Main of Boston, Massachusetts.
- i. Normal Operational Procedures - The movable spillway crest, the bascule gate, is automatically controlled by a float valve. A routine is established for the maintenance and testing of gates and operating equipment at regular intervals.

1.3 Pertinent Data

Elevations given in this report are on National Geodetic Vertical Datum (NGVD) formerly referred to as Mean Sea Level (MSL). Drawings contained in Appendix B are on a local datum which is approximately 445.3 feet below NGVD.

- b. Description of Dam and Appurtenances - Crescent Street Dam as it now exists is approximately 127 feet long and comprises of concrete area supporting a gatehouse at the right abutment, a 98 foot long concrete spillway weir and an intake and overflow weir complex at the left abutment. The height of the dam is approximately 28 feet based on the elevation at the top of the right abutment wall. The original length of the dam was probably greater than the 127 feet stated above due to backfill or embankments at the abutments. However, the existence of mill buildings on each side of the spillway area preclude an accurate determination of the original length of the dam.

The main portion of the dam, the spillway, was originally constructed of concrete. The crest of the weir was removed in 1939 and a new concrete facing was placed on the weir's upstream face and crest reducing the fixed weir crest height by three feet. A bascule gate was installed to allow impoundment of water to the original height of the weir. The concrete placed along the upstream face of the weir abuts the downstream face of an old timber dam. The weir has an inspection and pipe gallery present at its approximate centerline for the full length of the dam.

The dam has substantially no earth embankment except for an area of fill roughly 50 feet wide between the right abutment and the nearby turbine and drain discharge channels. This fill is retained by the concrete and stone masonry right training wall and the stone masonry foundation wall at the east end of the mill building across Crescent Street. The surface of this filled area is entirely covered by Crescent Street pavement and sidewalk, and by two small brick buildings and a paved yard belonging to the Starrett Company. The fill has a height of about 20 feet relative to the adjacent discharge channels.

A stone masonry intake is located upstream of the right abutment. Two seven foot diameter penstocks transmit water from the intake to the mill buildings to the right of the dam. A bar rack at the intake keeps debris from entering the penstocks.

An intake structure and overflow weir are present at the left abutment. The overflow weir is constructed of concrete and has a fixed crest. The intake, which is protected by a bar rack, is at the downstream end of the overflow weir.

- c. Size Classification - The Crescent Street Dam has an estimated maximum total storage of 82 acre-feet and a maximum hydraulic height (at elev. 549.3) of about 28 feet. Both the storage and the height classifies the dam in the "small" size category according to guidelines established by the Corps of Engineers.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
CRESCENT STREET DAM
MA 00934

SECTION 1: PROJECT INFORMATION

1.1 General

- a. Authority - Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region.

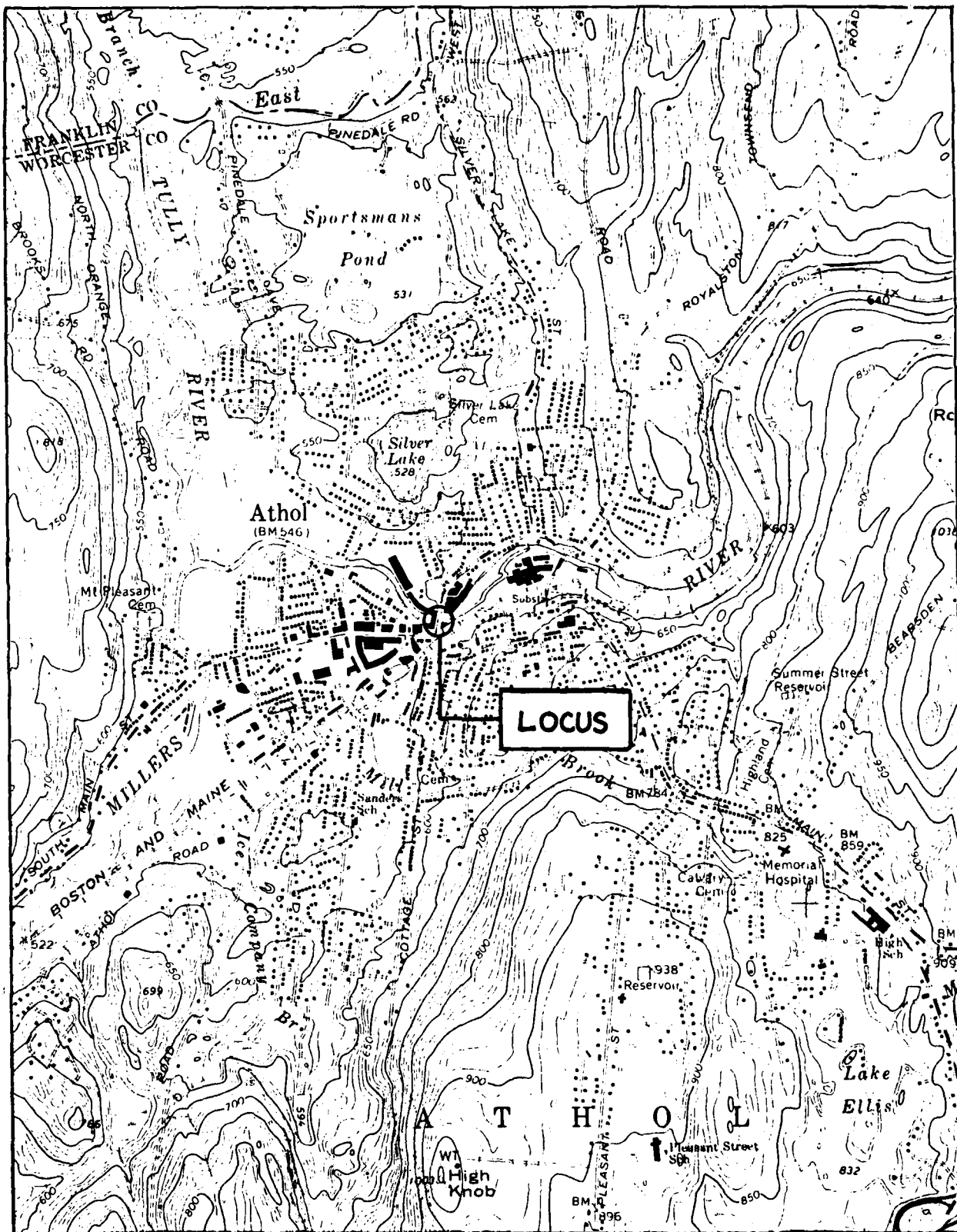
Camp Dresser & McKee Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Camp Dresser & McKee Inc. under letters of 12 July 1978 and 23 October 1978 from Colonel John P. Chandler, Corps of Engineers. Contract No. DACW 33-78-C-0354 has been assigned by the Corps of Engineers for this work. Haley and Aldrich, Inc. has been retained by Camp Dresser & McKee Inc. for soils and geological portions of the work.

- b. Purpose - The primary purpose of the investigation is to:

- (1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.
- (2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.
- (3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

- a. Location - Crescent Street Dam is located on the Millers River approximately 18 miles upstream of its confluence with the Connecticut River. The dam is immediately to the east of Crescent Street in the Town of Athol, Massachusetts.



DAM CRESCENT ST. DAM

IDENTIFICATION NO. MA 00934



LOCATION MAP
USGS QUADRANGLE

ATHOL, MASS.

APPROX. SCALE: 1" = 2000'

The above study provides estimated peak flood flows at the Crescent Street Dam of 11,000 cfs for the March 1936 flood and 16,000 cfs for the September 1938 flood.

- d. Visual Observations - During the field inspection, operation of the bascule gate was observed by raising the float valve manually. It took about 5 minutes to position the gate in the lowered position; after the pool level dropped about 2.5 feet in 15 minutes, the gate was rotated back to its raised position, again in 5 minutes. The outlet structure at the left bank contains a bar rack which conveys the flow into a 6-ft. diameter outlet conduit. The screened outlet on the right bank has two openings, one for turbines, and one for the bypass which is normally closed. Numerous manufacturing plants exist along both banks of the river. Large boulders were observed in the river bed; side slopes of the river were protected with concrete walls downstream of Crescent Street. High water levels of 1936 and 1938 floods were marked on the wall of the power building of the L.S. Starrett Co. which forms the left abutment of Crescent Street Dam.
- e. Test Flood Analysis - Based upon the Corps of Engineers Guidelines, the recommended test flood for the size "small" and the hazard potential "high" is within the range of 1/2 PMF to a full PMF (Probable Maximum Flood). The test flood was determined using Corps of Engineers Guidelines for "Estimating Maximum Probable Discharge" in Phase I Dam Safety Investigations. The peak inflow rate of 505 cfs/sq. mi. for the PMF as presented in the guidelines for the Millers River basin was adopted for this investigation since it is based on extensive studies for the Birch Hill Dam, a Corps of Engineers flood control project. This full PMF value was then reduced to 1/2 PMF as detailed below for the test flood.

The Birch Hill Dam and Reservoir is located on the Millers River about midway between Athol and Winchendon in the town of South Royalston. The drainage area at the dam is 175 sq. mi. while the drainage area at the Crescent Street Dam is 201 sq. mi. The Birch Hill reservoir was considered to be empty when the test flood (1/2 PMF) occurs. The peak rate of inflow for the PMF (88,400 cfs) was reduced to 44,200 cfs (1/2 PMF) and the ordinates for the Birch Hill Reservoir inflow hydrograph were adjusted accordingly. The test flood was then routed through Birch Hill Dam and Reservoir and the water level was found to rise to spillway crest elev. 852. about 30 hours after the onset the storm, thereby storing 49,900 acre-ft of the flood flow before discharge over the spillway. Flood routing of this storm through the reservoir results in a displacement of the peak outflow by sixteen hours with a consequent reduction in peak outflow to 21,000 cfs, slightly greater than a 52 percent

reduction. This peak outflow was then combined with the runoff from the uncontrolled 26 sq. mile watershed between Birch Hill Dam and Crescent Street to produce the test flood flow at the Crescent Street Dam. The hydrograph for this intervening drainage area was developed using a shape based on storm hydrographs recorded at Priest Brook near Winchendon (D.A. = 19.4 sq. mi.) and utilizing Corps Guidelines to develop a PMF peak flow of 19,500 cfs (750 cfs per sq. mile x 26 sq. mil. for rolling terrain) which was then halved to 9,750 cfs for the 1/2 PMF test flood. The 21,000 cfs peak outflow from Birch Hill Dam, when combined with the 9,750 cfs peak outflow occurring 16 hours earlier from the 26 sq. mile intervening drainage area, results in a combined storm hydrograph with a peak rate of 26,900 cfs at Crescent Street for the test flood. This compares with a spillway capacity at the top of the dam (top of right upstream channel wall at elevation 549.3) of 14,400 cfs. Although a detailed field survey would be necessary to define the level that water would rise to on the upstream side of the dam with the occurrence of the test flood flow of 26,900 cfs, indications are that once the water level exceeded elev. 554 (Sept. 1938 highwater at elev. 553.8), the ponded water would then flow out from behind the power plant on the left bank, down Main Street and then back into the Millers River. In order for the flood waters to flow behind the L.S. Starrett complex on the right bank of the river, it would be necessary for the water levels to build to about elev. 565, very unlikely because of the conveyancy available in Main Street. Therefore, the spillway can be considered capable of passing 25,900 cfs at approximate elev. 554, or about 96 percent of the test flood flow.

- f. Dam Failure Analysis - Based on Corps of Engineers Guidelines for Estimating Dam Failure hydrographs and assuming that a massive fracture failure would occur along 88-ft. section of the 98-ft. long spillway section of the dam, with the water level at elev. 553.8 (the level of the Sept. 1938 flood), the failure would result in a total failure flow of 24,300 cfs. This same failure flow would be produced by a failure of a 96-ft. section of the 98-ft. long spillway section with the water level at elev. 547.3. It has been noted that the flood of March, 1936 (11,000 cfs) destroyed the Crescent Street bridge while the September, 1938 flood (16,000 cfs) washed away 100 ft. of the north approach to the Exchange Street bridge while the Crescent Street bridge surface was inundated by 3-ft. Failure of the dam would place the downstream bridges and the wood frame structure spanning the river west of Crescent Street in jeopardy. The failure of the dam would also cause instantaneous flooding of the dam's pipe and inspection gallery and allow water to enter the lower levels of the Mill buildings. While these areas are not normally manned by large numbers of personnel, those who might be in this area would have their lives endangered by the flooding. Channel conveyance studies also indicate that the floodwall along the left bank of the river about 400-ft. downstream of Crescent Street would be overtopped by the estimated failure flow of 24,300 cfs. The potential loss of life from a dam failure is considered to be greater than 10 and the potential economic losses would be high. Consequently, this dam is classified as having a high hazard potential.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

- a. Visual Observation - There was no direct visible evidence of dam instability during the site examination on 15 November 1978. The slow surface settlement of the embankment area behind the right abutment could be due to loss of fill which could eventually affect the stability of the channel wall.
- b. Design and Construction Data - Drawings for the modification of the Crescent Street Dam, copies of which are included in Appendix B, show the general features of the dam but do not give data on the original construction nor the foundation. It is not practical to perform a theoretical analysis of the stability of the dam without this information. However, the design configuration appears reasonable and would be expected to be adequately stable under static loading conditions.
- c. Operating Records - No operating records other than inspection reports by the State and County were located.
- d. Post-Construction Changes - The dam had at least one major modification after its original construction. The change occurred in 1939 and comprised of reducing the fixed crest height, the placing of a concrete facing on the upstream face of the dam and the placing of a new concrete crest on the dam with a bascule gate. While other changes may have been made to the dam, they were not significant enough to be noticed during the site examination.
- e. Seismic Stability - Crescent Street Dam is located in Seismic Zone No. 2 and in accordance with recommended Phase I Guidelines does not warrant seismic analysis.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

- a. Condition - The visual examination of Crescent Street Dam did not reveal any evidence of impending failure or conditions which would warrant urgent remedial treatment. However, because of the need for maintenance and additional investigation that is outlined hereinafter, the project is considered to be in fair condition.
- b. Adequacy of Information - Generally, available drawings and other information gathered during the site examination were adequate for the Phase I Investigation. However, the information is not sufficient for a detailed evaluation of the probable settlement at the right abutment.
- c. Urgency - The recommended additional investigations and remedial measures outlined in Sections 7.2 and 7.3, respectively, should be undertaken within one year of receipt of the report by the Owner.
- d. Need for Additional Investigation - Additional investigation should be performed by the Owner as outlined in the following section.

7.2 Recommendations

It is recommended that the Owner engage a qualified registered professional engineer to perform the following:

- (1) A detailed hydrologic-hydraulic investigation to determine the adequacy of the spillway and discharge channel and any necessary modifications to provide adequate capacity.
- (2) Investigate the vibration present at the bascule gate when it is in the raised position and in operation to determine corrective action. It may be desirable to install knap breakers to minimize the condition.

7.3 Remedial Measures

- a. Operation and Maintenance Procedures - It is recommended that the following operation and maintenance procedures be adopted by the Owner to correct deficiencies noted during the visual examination:

- (1) Monitor the various cracks in the brick and concrete surface structures behind the right abutment and at the right end of the inspection gallery more systematically than has been done in the past, by establishing points that will permit movement. Measure and evaluate movements on a monthly basis. In addition, examine the low portions of the perimeter of the filled area at approximately monthly intervals, when water levels permit, to see if there is evidence of loss of fill. If surface movements continue, investigate further by checking below-water portions of the adjacent walls and by drilling through the surface slab to check for subsidence of the underlying fill. If any of the measurements or observations disclose a major or worsening problem, a registered professional engineer should be retained to make a thorough investigation.
- (2) Repair the concrete at the upstream end of the right intake and the downstream end of the weir at the left intake.
- (3) Remove debris from the inspection gallery and repair cracks at the roof springline and the area beneath the right abutment.
- (4) Compile the maintenance procedures in writing and expand where necessary for ready reference by the operating personnel. It should also contain provisions for the observation of the dam during periods of high precipitation, the annual technical inspection of the dam, an emergency preparedness plan and the details of operation of a warning system.

7.4 Alternatives - There are no recommended alternatives.

APPENDIX A - INSPECTION TEAM

ORGANIZATION AND CHECKLIST

Page No.

VISUAL INSPECTION PARTY ORGANIZATION

A-1

VISUAL INSPECTION CHECKLIST

Right Dam Embankment
Spillway
Bypass Spillway
Outlet Works-Bypass Spillway
Hydrologic-Hydraulic Considerations

A-2
A-3 & 4
A-5
A-6
A-7 & 8

VISUAL INSPECTION PARTY ORGANIZATION
NATIONAL DAM INSPECTION PROGRAM

DAM: Crescent Street

DATE: 15 November 1978

TIME: 8:30 AM

WEATHER: Clear to Partly Cloudy app, 45° to 50°F

WATER SURFACE ELEVATION UPSTREAM: 2.5" over steel bascule gate

STREAM FLOW: $(2.65)(100')^{1.5}(0.21) = 26 \text{ cfs} +$ (541.34)

INSPECTION PARTY:

1. Robert P. Howard - CDM
2. A. Ulvi Gulbey - CDM
3. Joseph E. Downing - CDM
4. Charles E. Fuller - CDM
5. Elwood C. Richardson - CDM
6. Peter LeCount - H & A

PRESENT DURING INSPECTION:

1. William D. Thorp of L.S. Starrett Company
2. _____
3. _____
4. _____

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Crescent Street

DATE: 11/15/78

EMBANKMENT: Rt. end of dam next to bldg.

CHECK LIST	CONDITION
<p>1. Upstream Slope</p> <p>a. Vegetation</p> <p>b. Sloughing or Erosion</p> <p>c. Rock Slope Protection - Riprap Failures</p> <p>d. Animal Burrows</p> <p>2. Crest</p> <p>a. Vegetation</p> <p>b. Sloughing or Erosion</p> <p>c. Surface cracks</p> <p>d. Movement or Settlement</p> <p>3. Downstream Slope</p> <p>a. Vegetation</p> <p>b. Sloughing or Erosion</p> <p>c. Surface cracks</p> <p>d. Animal Burrows</p> <p>e. Movement or Cracking near toe</p> <p>f. Unusual Embankment or Downstream Seepage</p> <p>g. Piping or Boils</p> <p>h. Foundation Drainage Features</p> <p>i. Toe Drains</p> <p>4. General</p> <p>a. Lateral Movement</p> <p>b. Vertical Alignment</p> <p>c. Horizontal Alignment</p> <p>d. Condition at Abutments and at Structures</p> <p>e. Indications of Movement of Structural Items</p> <p>f. Trespassing</p> <p>g. Instrumentation Systems</p>	<p>Note: There is no obvious earth embankment at this dam. Area between rt. dam abutment and bldg., incl. adjac. road, has earth fill behind concr. wall.</p> <p>1.</p> <p>a. None</p> <p>b. N.A.</p> <p>c. N.A.</p> <p>d. N.A.</p> <p>2.</p> <p>a. None</p> <p>b. N.A.</p> <p>c. Cracking in surface concrete of slab on grade parallel to right abutment, step cracking in brick gatehouse in same area.</p> <p>d. Slab cracking apparently due to backfill settlement behind upstream wall, est. 1 - 1-1/2".</p> <p>3.</p> <p>a. None</p> <p>b., c., d. N.A</p> <p>e. N.A.</p> <p>f. None observed</p> <p>g. None observed</p> <p>h. None known</p> <p>i. None known</p> <p>4.</p> <p>a. None observed</p> <p>b. Sl. settlement beh. wall</p> <p>c. Appears OK</p> <p>d. Apparent fill settlement behind abut. wall.</p> <p>e. None observed</p> <p>f. N.A.</p> <p>g. None</p>

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Crescent Street Dam

DATE: 15 November 1978

SPILLWAY: _____

CHECK LIST	CONDITION
<p>1. Approach Channel</p> <p>a. General Condition</p> <p>b. Obstructions</p> <p>c. Log Boom etc.</p> <p>2. Weir</p> <p>a. Flashboards</p> <p>b. Weir Elev. Control (Gate)</p> <p>c. Vegetation</p> <p>d. Seepage or Efflorescence</p> <p>e. Rust or Stains</p> <p>f. Cracks</p> <p>g. Condition of Joints</p> <p>h. Spalls, Voids or Erosion</p> <p>i. Visible Reinforcement</p> <p>j. General Struct. Condition</p> <p>3. Discharge Channel</p> <p>a. Apron</p> <p>b. Stilling Basin</p> <p>c. Channel Floor</p> <p>d. Vegetation</p> <p>e. Seepage</p> <p>f. Obstructions</p> <p>g. General Struct. Condition</p> <p>4. Walls</p> <p>a. Wall Location <u>Rt. D.S.</u></p> <p>(1) Vegetation</p> <p>(2) Seepage or Efflorescence</p> <p>(3) Rust or Stains</p> <p>(4) Cracks</p> <p>(5) Condition of Joints</p> <p>(6) Spalls, Voids or Erosion</p> <p>(7) Visible Reinforcement</p> <p>(8) General Struct. Condition</p> <p>4. b. Wall Location <u>Lt. D.S.</u></p>	<p>1.</p> <p>a. Walls are in good condition. Rt. wall shows some minor staining, spalls and efflorescence. Lt. wall shows some minor staining and efflorescence. The joints of the grouted stone masonry have spalled off at the water line. There are cracks on the thickened up portion of the conc. wall.</p> <p>b. None observed</p> <p>c. None</p> <p>2.</p> <p>a. None</p> <p>b. Good</p> <p>c. None observed</p> <p>d. None visible on the concrete face as observed from the downstream bridge. Some minor seepage at the control gate with no flow over crest.</p> <p>e. Minor staining</p> <p>f. None observed</p> <p>g. Good - observed from the downstream bridge.</p> <p>h. None observed</p> <p>i. None observed</p> <p>j. The observed portions of the spillway is good to excellent.</p> <p>3.</p> <p>a. Ledge and/or bedrock - O.K.</p> <p>b. None observed</p> <p>c. Submerged-unobservable</p> <p>d. None observed</p> <p>e. None observed</p> <p>f. Bridge</p> <p>g. Not applicable</p> <p>4.a. (1) None observed</p> <p>(2) None observed</p> <p>(3) Minor staining observed</p> <p>(4) Minor vertical crack.</p> <p>(5) Good</p> <p>(6) Minor spalling below drain pipe</p> <p>(7) None observed</p> <p>(8) Good to excellent</p> <p>4.b. See bypass spillway</p>

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Crescent Street Dam

DATE: 15 November 1978

SPILLWAY: _____

CHECK LIST	CONDITION
<p>5. Tunnel</p> <ul style="list-style-type: none"> a. General Condition b. Cracks c. Seepage or Efflorescence d. Rust or Stains e. Condition of Joints f. Spalls, Voids, or Erosion g. Visible Reinforcement 	<p>5.</p> <ul style="list-style-type: none"> a. Good. The installation on the steam pipes are deteriorating and breaking off. Floor of tunnel heavy with debris. b. Vertical crack at the junction of the spillway and rt. wall of upstream wall. Horizontal crack at springing line starting at the rt. wall and extending a little more than half way across the dam. c. Heavy amounts of efflorescence with moderate seepage at the vertical and horizontal crack. Minor efflorescence through the tunnel. d. Heavy rust and staining at the cracks. e. Good f. None observed g. None observed

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Crescent Street Dam

DATE: 15 November 1978

SPILLWAY: Bypass Spillway

CHECK LIST	CONDITION
1. Approach Channel a. General Condition b. Obstructions c. Log Boom etc.	1. a. See spillway b. None observed c. None observed
2. Weir a. Flashboards b. Weir Elev. Control (Gate) c. Vegetation d. Seepage or Efflorescence e. Rust or Stains f. Cracks g. Condition of Joints h. Spalls, Voids or Erosion i. Visible Reinforcement j. General Struct. Condition	2. a. None b. None c. Minor vegetation at downstream side of spillway. d. Minor seepage through mud gate e. Minor staining f. None observed g. Good h. Some spalling of conc. veneer of stone masonry wall downstream of spillway. i. Wire mesh of conc. veneer visible. j. Good
3. Discharge Channel a. Apron b. Stilling Basin c. Channel Floor d. Vegetation e. Seepage f. Obstructions g. General Struct. Condition	3. See spillway
4. Walls a. Wall Location _____ (1) Vegetation (2) Seepage or Efflorescence (3) Rust or Stains (4) Cracks (5) Condition of Joints (6) Spalls, Voids or Erosion (7) Visible Reinforcement (8) General Struct. Condition	

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Crescent Street Dam

DATE: 15 November 1978

OUTLET WORKS: Bypass Spillway

CHECK LIST	CONDITION
1. Inlet a. Obstructions b. Channel c. Structure d. Screens e. Stop Logs f. Gates	1. a. None observed b. Submerged - Not visible c. Good d. Excellent e. None observed f. Submerged - Not visible
2. Control Facility a. Structure b. Screens c. Stop Logs d. Gates e. Conduit f. Seepage or Leaks	2. N/A
3. Outlet a. Structure b. Erosion or Cavitation c. Obstructions d. Seepage or Leaks	3. N/A
4. Mechanical and Electrical a. Crane Hoist b. Hydraulic System c. Service Power d. Emergency Power e. Lighting f. Lightning Protection	4. N/A

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: CRESCENT STREET DAM

DATE: 15 NOVEMBER 1978

HYDROLOGIC-HYDRAULIC CONSIDERATIONS: _____

CHECK LIST	CONDITION
1. Upstream Watershed a. Type of Terrain b. Hydrologic Controls 2. Reservoir a. Type of Terrain b. Development 3. Spillway a. Adjacent Low Points b. Spillway Approach (Slope) c. Spillway Discharge (Slope) d. Spillway Type 4. Downstream Watershed a. Reach No. (1) Control (Bridge, dam, culvert, etc.) (2) Channel Characteristics (3) Development (4) Visible Utilities (5) Special Problems (Hospital, etc.)	1. a. Moderate to steep hills with some isolated mountains of moderate height (1000 to 2000 ft.) b. Runoff in the watershed is controlled by numerous lakes and ponds as well as Birch Hill Dam located at the confluence of Otter River and Millers River. 2. a. The terrain immediately adjacent to the pool created by the dam is very steep, averaging 10% to a maximum of 20%. b. Other than the L.S. Starrett Co. complex which occupies both banks of the pool created by the dam, little development exists except 30 to 40 feet above the river level along the north bank. 3. a. There are no adjacent low points. All flow is either over the spillway or through auxiliary gates. The L.S. Starrett Co. controls the flow. b. The stream bed approach to the dam has a slope of about 1%. c. Downstream of the dam, the stream bed fattens to about 0.5%. d. The spillway is a concrete encased stone dam with a 100-foot long steel bascule gate. 4. a. <u>Reach No. 1</u> --Crescent Street bridge to Exchange Street bridge. 1. Exchange Street bridge 2. Ledge immediately downstream with rock and boulders extending about 1000 ft. in the direction of Exchange Street. 3. Channel boundaries formed by masonry buildings on both banks with concrete flood wall to contain river where buildings do not abut. 4. None

APPENDIX A-7

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: (CONT'D) DATE: 15 NOVEMBER 1978
HYDROLOGIC-HYDRAULIC CONSIDERATIONS: _____

CHECK LIST	CONDITION
<ol style="list-style-type: none"> 1. Upstream Watershed <ol style="list-style-type: none"> a. Type of Terrain b. Hydrologic Controls 2. Reservoir <ol style="list-style-type: none"> a. Type of Terrain b. Development 3. Spillway <ol style="list-style-type: none"> a. Adjacent Low Points b. Spillway Approach (Slope) c. Spillway Discharge (Slope) d. Spillway Type 4. Downstream Watershed <ol style="list-style-type: none"> a. Reach No. <ol style="list-style-type: none"> (1) Control (Bridge, dam, culvert, etc.) (2) Channel Characteristics (3) Development (4) Visible Utilities (5) Special Problems (Hospital, etc.) 	<ol style="list-style-type: none"> 5. (cont'd) <p>Exchange Street bridge reconstructed 7-ft higher with increased width of opening after September, 1938 flood.</p>

**COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER**

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O. Narden Date 7-24-1938 Dam No. 02-06

Town Athol Location Millers River.

Owner L.S. Starrett Estate. Use _____

Material and Type _____

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. Streambed _____

Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____

Width Flashboards carried _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____

Kind of Foundation under Spillway _____

Condition water about 18 inhes over spillway -not dangerous.

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Bottom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition _____

GATES _____ Location _____

Size _____ Kind _____ El. Flowline _____

Condition _____

WHEEL _____ Kind _____ Size _____ Rated H. P. _____

Location _____ Ave. Head _____

Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Topography of Country below Dam _____

Nature of Buildings and Roads below Dam _____

Number Acres in Pond _____ Drainage Area in Square Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

APPENDIX B-12

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by Mr. Ball, L. O. M., Shultz Date 6/4/36 Dam No. 02-06

Town Athol Location Millers River

Owner L. S. Starrett Mfg. Co. Use

Material and Type Discuss and approve plans of wall to be built along banks of Millers River about 70 feet from dam.

Dam Designed by Constructed by Year

SPILLWAY—Length Feet Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O.M., E.M. Crockett Date 3/15/56 Dam No. 02-06

Town Athol Location Millers River

Owner L.A. S. Starrett Estate Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY—Length Feet Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Ok, but believe surface should be reconcreted under pressure

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition Ok

GATES Location

Size Kind El. Flowline

Condition OK

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

APPENDIX B-10

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O.M., G.W. Jones Date 3/22/56 Dam No. 02-0

Town Athol Location Millers River

Owner L.S. Starrett Estate Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY—Length Feet Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Dam held during flood, appears OK

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

APPENDIX B-9

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L. O. M. Date 3/15/36 Dam No. 02-16

Town Athol Location Millers River

Owner L. S. Starrett Estate Use

Material and Type Ice Jam. Knock off corner Starrett four(4)-story
brick building.

Dam Designed by Constructed by Year

SPILLWAY—Length Feet. Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Dam held OK

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition OK

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

APPENDIX B-8

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O. Marden Date 11-27-1935 Dam No. 02-06

Town Athol Location Millers River

Owner L.S. Starrett Est. Use power

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition should resurface portions of oggee spillway face.

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES

Size Kind El. Flowline

Condition

WHEEL

Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

APPENDIX B-7

**COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER**

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O. Marden Date 4-2D-1933 Dam No. 02-06

Town Athol Location Starretts Dam.

Owner Starrett Estate Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition about 4 feet of water over crest-extreme high water.
otherwise O.K.

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

APPENDIX B-6

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O. Marden Date Dec. 14, 1931 Dam No. OE- 36

Town Athol Location Millers River.

Owner Starrett Estate Use storage & power

Material and Type

Dam Designed by Constructed by Year

SPILLWAY—Length Feet. Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition OK, except could possibly grout under pressure cracks in concrete of spillway.

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition OK

GATES Location

Size Kind El. Flowline

Condition OK

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

APPENDIX B-5

**COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER**

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O. Marden Date Feb. 16, 1928 Dam No. 02-06

Town Athol Location _____

Owner L.S. Starrett Est. Use _____

Material and Type _____

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. Streambed _____

Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____

Width Flashboards carried _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____

Kind of Foundation under Spillway _____

Condition good.

EMBANKMENT NONE

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Bottom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition _____

GATES

Location _____

Size _____ Kind _____ El. Flowline _____

Condition good.

WHEEL Kind _____ Size _____ Rated H. P. _____

Location _____ Ave. Head _____

Evidence of Leaks in Structure none

Recent Repairs and Date none

Topography of Country below Dam _____

Nature of Buildings and Roads below Dam _____

Number Acres in Pond _____ Drainage Area in Square Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

APPENDIX B-4

Decree No.

Dam No. 02-36

**COUNTY OF WORCESTER, MASSACHUSETTS
OFFICE OF COUNTY ENGINEER**

Neg. Nos.

INSPECTION OF DAMS, RESERVOIR DAMS AND RESERVOIRS

Town Athol Date Aug. 15, 1927 Dam No. 02-05
Dec. 15, 1925
 Location Millers river above Crescent st. Name of Pond or Stream Millers River
 Inspected by L.O. Marden
 Owner L.S. Starrett Est. Use
 MATERIAL & TYPE See book 5, page 97

Elevations in feet: above (+) or below (-) full pond or reservoir level.

FOR DAM Bed of stream below top of spillway

FOR RESERVOIR

top of dam top of flashboards ground surface below

..... level of overflow pipe length in feet

width top in feet width bottom in feet size pipe to mill

..... inches length spillway in feet head in feet

Size of wheel H. P. developed

Size of gates location of gates

Foundation and details of construction

..... condition of embankment

Constructed by date

Designed by location

Recent repairs and date

Evidence of leakage

Condition Good

Topography of country below

Nature of buildings and roads below dam

No. Acres in watershed No. Acres in pond

Plans secured Percent watershed in cultivation

Percent in forests Note: Cross out word not applicable

**COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER**

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O. Marden Date Nov. 14, 1923 Dam No. 02-16

Town Athol Location Millers River.
Owner L.S. Starrett Est. Use Storage & Power
Material and Type Ogee-Rein. Concrete-hollow inside -steam and water pipes
inside dam in passageway. also electric wires.

Dam Designed by Geo. H. Cutting Co. Constructed by Geo. H. Cutting & Co. 1901
Worcester

SPILLWAY LENGTH- 114.
El. top Abutment El. Crest 100. El. Apron El. Streambed 12.
Width top Abutment Width top Crest Width bottom Spillway Width bottom Spillway
Width Flashboards carried none. Kind Flashboards --
El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe
Kind of Foundation under Spillway 50 percent ledge. dovetailed on ledge.
Condition good.

EMBANKMENT no embankment-
El. Top El. Natural Ground Width Top Width Top
Width of Bottom Upstream Slope Downstream Slope Downstream Slope
Kind of Corewall Riprap
Material in Embankment Foundation
Condition --

GATES Location Location
Size Kind El. Flowline El. Flowline
Condition Condition

7 ft. tube 256 H.P.
WHEEL 7 ft. tube Kind Size Rated H.P. 96.
Location Ave. Head 15. & 18'
Evidence of Leaks in Structure none.

Recent Repairs and Date none.
Topography of Country below Dam Town of Athol

Nature of Buildings and Roads below Dam Town of Athol.

Number Acres in Pond 5.2 Drainage Area in Square Miles 201.
Discharge in Second Feet per Square Mile 80°/efficiency. 1.290
Estimated Storage Million Cubic Feet Estimated Storage Million Cubic Feet

APPENDIX B-2

LIST OF DOCUMENTS

CRESCENT STREET DAM

DOCUMENT

LOCATION

- | | |
|---------------------------------------|--|
| 1. Crest Gate Sectional Details | Worcester County Courthouse, Worcester, MA |
| 2. Crest Gate & Elevation View of Dam | Worcester County Courthouse, Worcester, MA |
| 3. Plan View of Dam | Worcester County Courthouse, Worcester, MA |

APPENDIX B (cont'd)

<u>DATE</u>	<u>BY</u>	<u>Page No.</u>
31. March 6, 1944	County of Worcester, Mass.	B-32
32. June 14, 1948	County of Worcester, Mass.	B-33
33. March 17, 1950	County of Worcester, Mass.	B-34
34. February 16, 1951	County of Worcester, Mass.	B-35
35. March 19, 1954	County of Worcester, Mass.	B-36
36. July 7, 1958	County of Worcester, Mass.	B-37
37. October 11, 1958	County of Worcester, Mass.	B-38
38. February 2, 1959	County of Worcester, Mass.	B-39
39. April 7, 1960	County of Worcester, Mass.	B-40
40. November 24, 1964	County of Worcester, Mass.	B-41
41. March 19, 1968	County of Worcester, Mass.	B-42
42. March 19, 1968	County of Worcester, Mass.	B-43
43. March 10, 1969	County of Worcester, Mass.	B-44
44. March 27, 1970	County of Worcester, Mass.	B-45
45. January 7, 1972	Mass. Dept. of Public Works	B-46

DRAWINGS

<u>NO.</u>	<u>TITLE</u>	
1.	Crest Gate Sectional Details *	B-47
2.	Crest Gate & Elevation of Dam *	B-48
3.	Plan of Dam	B-49

* Elevations given on these drawings are on an assumed datum. To convert to NVGD, add 445 feet to the elevations given on plates B-47 and B-48.

APPENDIX B

LIST OF AVAILABLE DOCUMENTS AND
PRIOR INSPECTION REPORTS

Page No.

LIST OF AVAILABLE DOCUMENTS

B-1

PRIOR INSPECTION REPORTS

<u>DATE</u>	<u>BY</u>	
1. November 14, 1923	County of Worcester, Mass.	B-2
2. December 15, 1925 & August 25, 1927	County of Worcester, Mass.	B-3
3. February 16, 1928	County of Worcester, Mass.	B-4
4. December 14, 1931	County of Worcester, Mass.	B-5
5. April 20, 1933	County of Worcester, Mass.	B-6
6. November 27, 1935	County of Worcester, Mass.	B-7
7. March 15, 1936	County of Worcester, Mass.	B-8
8. March 22, 1936	County of Worcester, Mass.	B-9
9. March 25, 1936	County of Worcester, Mass.	B-10
10. June 4, 1936	County of Worcester, Mass.	B-11
11. July 24, 1938	County of Worcester, Mass.	B-12
12. October 19, 1938	County of Worcester, Mass.	B-13
13. October 26, 1938	County of Worcester, Mass.	B-14
14. November 12, 1938	County of Worcester, Mass.	B-15
15. December 6, 1938	County of Worcester, Mass.	B-16
16. December 7, 1938	County of Worcester, Mass.	B-17
17. January 6, 1939	County of Worcester, Mass.	B-18
18. January 16, 1939	County of Worcester, Mass.	B-19
19. March 1, 1939	County of Worcester, Mass.	B-20
20. March 16, 1939	County of Worcester, Mass.	B-21
21. May 22, 1939	County of Worcester, Mass.	B-22
22. June 7, 1939	County of Worcester, Mass.	B-23
23. September 13, 1939	County of Worcester, Mass.	B-24
24. November 22, 1939	County of Worcester, Mass.	B-25
25. April 13, 1940	County of Worcester, Mass.	B-26
26. June 17, 1940	County of Worcester, Mass.	B-27
27. February 19, 1941	County of Worcester, Mass.	B-28
28. May 20, 1942	County of Worcester, Mass.	B-29
29. November 27, 1942	County of Worcester, Mass.	B-30
30. November 26, 1943	County of Worcester, Mass.	B-31

**COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER**

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by County Com. LOM. Date 10-12-1938 Dam No. General

Town Athol Location Millers River.

Owner _____ Use _____

Material and Type County Com. view damage across from Union Twist Drill Co.
also visit Starrett and the Athol Mfg Co. dams and view same.

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. Streambed _____

Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____

Width Flashboards carried _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____

Kind of Foundation under Spillway _____

Condition _____

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Bottom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition _____

GATES _____ Location _____

Size _____ Kind _____ El. Flowline _____

Condition _____

WHEEL _____ Kind _____ Size _____ Rated H. P. _____

Location _____ Ave. Head _____

Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Topography of Country below Dam _____

Nature of Buildings and Roads below Dam _____

Number Acres in Pond _____ Drainage Area in Square Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

APPENDIX B-13

**COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER**

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L. O. Marden Arthur Starrett Date Oct. 26, 1938 Dam No. 02-06

Town Athol Location Millers River.

Owner L. S. Starrett Estate Use

Material and Type Discuss Starrett dam and Millers River control.

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

APPENDIX B-14

COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L. O. Marden Date 11-12-1938 Dam No. 02-06

Town Athol Location Millers River
Owner L. S. Starrett Mfg. Co. Use _____
Material and Type Arthur Starrett-Small of C. T. Main Co-J. R. Worcester-
Ed. Clair-Mr. Ball-Burdon- etc- view present dam with regard to cutting
down top of spillway.
Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. Streambed _____
Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____
Width Flashboards carried _____ Kind Flashboards _____
El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____
Kind of Foundation under Spillway _____
Condition _____

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____
Width of Bottom _____ Upstream Slope _____ Downstream Slope _____
Kind of Corewall _____ Riprap _____
Material in Embankment _____ Foundation _____
Condition _____

GATES

Location _____
Size _____ Kind _____ El. Flowline _____
Condition _____

WHEEL

Kind _____ Size _____ Rated H. P. _____
Location _____ Ave. Head _____
Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Topography of Country below Dam _____

Nature of Buildings and Roads below Dam _____

Number Acres in Pond _____ Drainage Area in Square Miles _____
Discharge in Second Feet per Square Mile _____
Estimated Storage Million Cubic Feet _____

APPENDIX B-15

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by R. St. John Date Dec 6-38 Dam No. 02-06

Town Attleboro Location _____

Owner L. S. Hackett Co. Use _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. St. Bed _____

Width top Abut. _____ Width top Crest _____ Width bottom Sp. way _____

Width flashboards _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Pipe _____

Kind of Foundation under Spillway _____

Condition Water 2' 3" over top of dam.

Water receding

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Bottom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition _____

GATES

Open Location _____

Size _____ Kind _____ El. Flowline _____

Condition _____

Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Number Acres in Pond _____ Drainage Area in Sq. Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

**COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER**

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L. O. Marden & E. H. Crockett Date 12-7-38 Dam No. 02-06

Town Athol Location Millers River

Owner L. S. Starrett Est. Use _____

Material and Type _____

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. Streambed _____

Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____

Width Flashboards carried _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____

Kind of Foundation under Spillway _____

Condition O.K., about 8 inches water over spillway crest.

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Bottom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition _____

GATES _____ Location _____

Size _____ Kind _____ El. Flowline _____

Condition _____

WHEEL _____ Kind _____ Size _____ Rated H. P. _____

Location _____ Ave. Head _____

Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Topography of Country below Dam _____

Nature of Buildings and Roads below Dam _____

Number Acres in Pond _____ Drainage Area in Square Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

APPENDIX B-17

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by S. J. Brown Date Jan 6 1939 Dam No. 02-06

Town Alford Location Williams River
Owner State of Mass. Use

SPILLWAY

El. top Abutment El. Crest El. Apron El. St. Bed
Width top Abut. Width top Crest Width bottom Sp. way
Width flashboards Kind Flashboards
El. Flowline Cleanout Pipe Size and Kind Pipe
Kind of Foundation under Spillway
Condition Large hole in apron at 2.3 F.M.
about 1 ft. deep

EMBANKMENT

El. Top El. Natural Ground Width Top
Width of Bottom Upstream Slope Downstream Slope
Kind of Corewall Riprap
Material in Embankment Foundation
Condition

GATES

Location
Size Kind El. Flowline
Condition

Evidence of Leaks in Structure

Recent Repairs and Date

Number Acres in Pond Drainage Area in Sq. Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Eng. O'Connell-Mr. Perley
Inspected by L.O. Marden Date 1-16-1939 Dam No. 02-06

Town Athol Location Millers River.

Owner L.S. Starrett Estate Use

Investigate ice conditions in Starrett Mill Pond- My opinion no hazard

El. top abutment El. Crest El. Apron El. St. Bed

Width top Abut. Width top Crest Width bottom Sp. way

Width flashboards Kind flashboards

El. Flowline Cleanout Pipe Size and Kind Pipe

Kind of Foundation under Spillway

Condition

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Borrom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES

Location

Size Kind El. Flowline

Condition

Evidence of Leaks in Structure

Recent Repairs and Date

Number Acres in Pond Drainage Area in Sq. Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by M. A. Casella Date 3-1-39 Dam No. 02-08

Town Athol Location Crescent Street

Owner L. S. Starrett Co. Use Power

Concrete
SPILLWAY El. water 1'4" over spillway - 8:00 A.M.
El. top abutment El. Crest El. Apron El. St. Bed

Width top Abut. Width top Crest Width bottom Sp. way

Width flashboards Kind flashboards

El. Flowline Cleanout Pipe Size and Kind Pipe

Kind of Foundation under Spillway

Condition

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Borrom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES

Closed

Location

Size Kind El. Flowline

Condition

Evidence of Leaks in Structure

Recent Repairs and Date

Number Acres in Pond Drainage Area in Sq. Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by St. John Date March 16, 39 Dam No. 02-06

Town Rehoboth Location _____
Owner S. J. Stewart Use _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. St. Bed _____
Width top Abut. _____ Width top Crest _____ Width bottom Sp. way _____
Width flashboards _____ Kind Flashboards _____
El. Flowline Cleanout Pipe _____ Size and Kind Pipe _____
Kind of Foundation under Spillway _____
Condition Gate opens. Water 1 foot over crest of dam.

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____
Width of Bottom _____ Upstream Slope _____ Downstream Slope _____
Kind of Corewall _____ Riprap _____
Material in Embankment _____ Foundation _____
Condition _____

GATES

Location _____
Size _____ Kind _____ El. Flowline _____
Condition _____

Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Number Acres in Pond _____ Drainage Area in Sq. Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

**COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER**

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O. Harden-R.P. St. John Date 5-22-1939 Dam No. 02-06

Town Athol Location Millers River

Owner L.S. Starrett Estate Use power

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition OK top not removed

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition OK

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

APPENDIX B-22

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by P.O.M. Date 6-7-39 Dam No. 02-06

Town Andover Location Mullen Pond Reservoir
Owner P.S. Starnett Mfg. Co. Use _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. St. Bed _____
Width top Abut. _____ Width top Crest _____ Width bottom Sp. way _____
Width flashboards _____ Kind Flashboards _____
El. Flowline Cleanout Pipe _____ Size and Kind Pipe _____
Kind of Foundation under Spillway _____
Condition _____

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____
Width of Bottom _____ Upstream Slope _____ Downstream Slope _____
Kind of Corewall _____ Riprap _____
Material in Embankment _____ Foundation _____
Condition _____

GATES

Location _____
Size _____ Kind _____ El. Flowline _____
Condition _____

Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Number Acres in Pond _____ Drainage Area in Sq. Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by L.O. Morden-A.H. Starrett Date 9-13-1939 Dam No. 02-06

Town Athol Location Millers River-their mill pond.

Owner Starrett Estate. Use _____

SPILLWAY

El. top abutment _____ El. Crest _____ El. Apron _____ El. St. Bed _____

Width top Abut. _____ Width top Crest _____ Width bottom Sp. way _____

Width flashboards _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Pipe _____

Kind of Foundation under Spillway _____

Condition examine concrete being poured in abutments, and under steel foundations of new bascule gates. is OK.

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Borrom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition _____

GATES

Location _____

Size _____ Kind _____ El. Flowline _____

Condition _____

Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Number Acres in Pond _____ Drainage Area in Sq. Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

**COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER**

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L. O. Marden Date 11-22-39 Dam No. 02-16

Town Athol Location Millers River

Owner L. S. Starrett Estate Use _____

Material and Type Final Inspection

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. Streambed _____

Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____

Width Flashboards carried _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____

Kind of Foundation under Spillway _____

Condition new gates and concrete abts O.K.

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Bottom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition _____

GATES _____ Location _____

Size _____ Kind _____ El. Flowline _____

Condition OK

WHEEL _____ Kind _____ Size _____ Rated H. P. _____

Location _____ Ave. Head _____

Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Topography of Country below Dam _____

Nature of Buildings and Roads below Dam _____

Number Acres in Pond _____ Drainage Area in Square Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O.Marden Date 4-13-1940 Dam No. 02-06

Town Athol Location Millers River

Owner L.S.Starrett Estate Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY—Length Feet Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition have lowered no gates on spillway account high water OK

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

TOWN Attol

DAM NO. 02-06

LOCATION Miller - Above Starrett Dam

STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS
DAM INSPECTION REPORT

OWNED BY L. S. Starrett Co

PLACE Attol

USE _____

INSPECTED BY L. C. M. - J. P.

DATE April 7, 1960

TYPE OF DAM _____

CONDITION _____

SPILLWAY

FLASHBOARDS IN PLACE None

RECENT REPAIRS _____

CONDITION Handled High H₂O

REPAIRS NEEDED _____

EMBANKMENT

RECENT REPAIRS Atts only

CONDITION OK

REPAIRS NEEDED _____

GATES

RECENT REPAIRS _____

CONDITION _____

REPAIRS NEEDED _____

LEAKS

HOW SERIOUS _____

DATE _____

COUNTY ENGINEER _____

APPENDIX B-40

TOWN Attleboro DAM NO. 02-06
LOCATION _____ STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by CHS Barrett Mfg Co Place _____ Use _____
Inspected by E. Teir & LOM Date Feb. 2, 1959
Type of Dam _____ Condition _____

SPILLWAY

Flashboards in Place _____ Recent Repairs _____
Condition _____
Repairs Needed _____

EMBANKMENT

Recent Repairs _____
Condition _____
Repairs Needed _____

GATES

Recent Repairs _____
Condition _____
Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ County Engineer _____

TOWN Attleboro DAM NO. 02-06
LOCATION Miller River STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by L. S. Starnett Mfg Co Place Attleboro Use _____
Inspected by L. O. M. Date OCT. 11, 1948
Type of Dam _____ Condition _____

SPILLWAY

Flashboards in Place None - Backup Recent Repairs _____
Condition Good
Repairs Needed _____

EMBANKMENT

Recent Repairs _____
Condition Concrete Spillway abts only
Repairs Needed None

GATES

Recent Repairs None
Condition Good
Repairs Needed None

LEAKS

How Serious None visible

DATE: OCT. 11, 1948 L. O. Marden County Engineer

TOWN Athol DAM NO. 02-06

LOCATION Millers River STREAM Starrett Pond

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by L.S. Starrett Inc Place Athol Use

Inspected by L.D.M. Date July 7, 1958

Type of Dam Concrete open spillway dam Condition Good

SPILLWAY

Flashboards in Place Basault Gates Recent Repairs None

Condition Can be raised electrically during floods

Repairs Needed None

EMBANKMENT

Recent Repairs None

Condition No Emb

Repairs Needed

GATES

Recent Repairs None

Condition OK

Repairs Needed None

LEAKS

How Serious None visible

DATE: July 7, 1958 L.D. Marden County Engineer

TOWN Attol

DAM NO. 02-08

LOCATION _____

STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Sherris PLACE _____ USE _____

INSPECTED BY L.H. Spafford DATE 3/1/54

TYPE OF DAM _____ CONDITION _____

SPILLWAY

FLASHBOARDS IN PLACE _____ RECENT REPAIRS _____

CONDITION _____

REPAIRS NEEDED _____

Entire Dam in good condition

EMBANKMENT

RECENT REPAIRS _____

CONDITION _____

REPAIRS NEEDED _____

GATES

RECENT REPAIRS _____

CONDITION _____

REPAIRS NEEDED _____

LEAKS

HOW SERIOUS _____

DATE _____

COUNTY ENGINEER _____

TOWN Athol

DAM NO. 02-06

LOCATION Center, Crescent St

STREAM Millers R

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY L. S. Starret Co.

PLACE Athol

USE power etc

INSPECTED BY L. O. Marden

DATE Feb. 16, 1951

TYPE OF DAM Concrete case

CONDITION good

SPILLWAY

FLASHBOARDS IN PLACE

RECENT REPAIRS

CONDITION

REPAIRS NEEDED none

EMBANKMENT

RECENT REPAIRS

CONDITION

REPAIRS NEEDED none

GATES

RECENT REPAIRS

CONDITION

REPAIRS NEEDED none

LEAKS

HOW SERIOUS none visible as water over crest

DATE

COUNTY ENGINEER

TOWN Attleboro

DAM NO. 02-06

LOCATION Center

STREAM Millers R

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS
DAM INSPECTION REPORT

OWNED BY L. S. Starrett Co. PLACE Attleboro USE Powr etc

INSPECTED BY L. O. M. DATE March 17, 1958

TYPE OF DAM concrete ogee spillway with bascule CONDITION Appears OK
gates

SPILLWAY

FLASHBOARDS IN PLACE _____ RECENT REPAIRS _____

CONDITION _____

REPAIRS NEEDED _____

EMBANKMENT

RECENT REPAIRS _____

CONDITION _____

REPAIRS NEEDED _____

GATES

RECENT REPAIRS None

CONDITION Appears OK

REPAIRS NEEDED None

LEAKS

HOW SERIOUS None visible

DATE March 17, 1958

L. O. M.

COUNTY ENGINEER

APPENDIX B-34

TOWN Athol

DAM NO. 9F-06

LOCATION Crescent St

STREAM Millers R

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY L. L. Barrett Co. PLACE Athol USE power etc

INSPECTED BY H. V. Liden DATE June 16, 1948

TYPE OF DAM ogee concrete CONDITION good

SPILLWAY

FLASHBOARDS IN PLACE yes RECENT REPAIRS none

CONDITION good

REPAIRS NEEDED none

EMBANKMENT None

RECENT REPAIRS none

CONDITION

REPAIRS NEEDED

GATES

RECENT REPAIRS none

CONDITION good

REPAIRS NEEDED none

LEAKS

HOW SERIOUS none visible.

DATE

COUNTY ENGINEER

APPENDIX B-33

WORCESTER COUNTY ENGINEERING DEPT.
WORCESTER, MASS.

DATE *March 6, 1944.*

SUBJECT: *Athol Dam Inspection.* *Dam No. 02-06*
TO *Miller River.*

This river dam is in good condition
Owned by U. S. Starrett Est

CAR USED *Sally*
CAR MILEAGE
FND TRIP
RENT TRIP
TRIP FEE

S. O. Kardon

SIGNATURE

APPENDIX B-32

**COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER**

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by..... LOM..... Date NOV. 26, 1943. Dam No. 02-06

Town..... Athol..... Location..... Millers River

Owner..... L.S. Starrett Mfg. Co. Use.....

Material and Type.....

Dam Designed by..... Constructed by..... Year.....

SPILLWAY

El. top Abutment..... El. Crest..... El. Apron..... El. Streambed.....

Width top Abutment..... Width top Crest..... Width bottom Spillway.....

Width Flashboards carried..... Kind Flashboards.....

El. Flowline Cleanout Pipe..... Size and Kind Cleanout Pipe.....

Kind of Foundation under Spillway.....

Condition..... OK

EMBANKMENT

El. Top..... El. Natural Ground..... Width Top.....

Width of Bottom..... Upstream Slope..... Downstream Slope.....

Kind of Corewall..... Riprap.....

Material in Embankment..... Foundation.....

Condition..... OK

GATES

Location.....

Size..... Kind..... El. Flowline.....

Condition..... OK

WHEEL..... Kind..... Size..... Rated H. P.

Location..... Ave. Head.....

Evidence of Leaks in Structure..... none visible.

Recent Repairs and Date.....

Topography of Country below Dam.....

Nature of Buildings and Roads below Dam.....

Number Acres in Pond..... Drainage Area in Square Miles.....

Discharge in Second Feet per Square Mile.....

Estimated Storage Million Cubic Feet.....

COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by M. F. Hunt Date 11-27-42 Dam No. 02-06

Town Worcester Location Willow River

Owner L. S. Sturtevant Use _____

Material and Type _____

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. Streambed _____

Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____

Width Flashboards carried _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____

Kind of Foundation under Spillway _____

Condition O.K.

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Bottom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition O.K.

GATES

Size _____ Kind _____ Location _____ El. Flowline _____

Condition O.K.

WHEEL

Kind _____ Size _____ Rated H. P. _____

Location _____ Ave. Head _____

Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Topography of Country below Dam _____

Nature of Buildings and Roads below Dam _____

Number Acres in Pond _____ Drainage Area in Square Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L. O. M. Date 5-20-42 Dam No. 02-06

Town Athol Location Miller R.

Owner Starrett Mfg. Co. Use

Material Dam From

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition OK

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES

Size Kind Location El. Flowline

Condition OK

WHEEL

Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure none visible

Recent Repairs and Date None

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by Lm - U. J. Owen Date 2-19-41 Dam No. 02-06

Town Attis Location Mullins Pond

Owner P. J. Starnett Associates Use _____

SPILLWAY
El. top abutment _____ El. Crest _____ El. Apron _____ El. St. Bed _____
Width top Abut. _____ Width top Crest _____ Width bottom Sp. way _____
Width flashboards _____ Kind flashboards _____
El. Flowline Cleanout Pipe _____ Size and Kind Pipe _____
Kind of Foundation under Spillway _____
Condition Good

EMBANKMENT
El. Top _____ El. Natural Ground _____ Width Top _____
Width of Borrom _____ Upstream Slope _____ Downstream Slope _____
Kind of Corewall _____ Riprap _____
Material in Embankment _____ Foundation _____
Condition Good

GATES Location _____
Size _____ Kind _____ El. Flowline _____
Condition Good

Evidence of leaks in structure _____

Recent Repairs and Date _____

Number Acres in Pond _____ Drainage Area in Sq. Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

**COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER**

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O. Marden Date 6-17-1940 Dam No. 02-06

Town Athol Location Millers River.

Owner L.S. Starrett Est. Use _____

Material and Type _____

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. Streambed _____

Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____

Width Flashboards carried _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____

Kind of Foundation under Spillway _____

Condition OK

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Bottom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition _____

GATES

Size _____ Kind _____ Location _____ El. Flowline _____

Condition _____

WHEEL _____ Kind _____ Size _____ Rated H. P. _____

Location _____ Ave. Head _____

Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Topography of Country below Dam _____

Nature of Buildings and Roads below Dam _____

Number Acres in Pond _____ Drainage Area in Square Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

APPENDIX B-27

TOWN Athol DAM NO. 02-06
LOCATION on Elyria of Crescent St. STREAM Millers River

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by L.S. Hurrott Co. Place Athol Use Mill Pond
Inspected by W.C.C. Date Nov. 24, 1964
Type of Dam Stone - Concrete Condition Good

SPILLWAY

Flashboards in Place _____ Recent Repairs _____
Condition Good
Repairs Needed Present water level 6" below crest
- Steel Bascule Gate on top of spillway

EMBANKMENT

Recent Repairs _____
Condition Good
Repairs Needed _____

GATES

Recent Repairs _____
Condition Good - Now open to Mills
Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ County Engineer

TOWN Athol
LOCATION Crescent St.

DAM NO. 02-06
STREAM Millers River

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by L. S. Harris Place Athol Use Mill Pond
Inspected by F. C. Corrigan Date 3/9/68
Type of Dam Concrete Condition ok

SPILLWAY

Flashboards in Place _____ Recent Repairs _____
Condition _____
Repairs Needed On this date there is a large ice jam in the river above this dam. The Union Twist Drill Bore.

EMBANKMENT

Recent Repairs _____
Condition _____
Repairs Needed _____

GATES

Recent Repairs _____
Conditions _____
Repairs Needed _____

LEAKS

How Serious _____
DATE: _____

County Engineer

677
TOWN Athol DAM NO. 02-06

LOCATION Crescent St. STREAM Millers River

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by A. J. Sturcott Co. Place Athol Use Mill Pond

Inspected by R.P.-R.P.-E.M. Date 3-19-68

Type of Dam Bascule Gate Condition Good

SPILLWAY

Flashboards in Place _____ Recent Repairs _____

Condition _____

Repairs Needed Flood Patrol

EMBANKMENT

Recent Repairs _____

Condition _____

Repairs Needed _____

GATES

Recent Repairs _____

Condition _____

Repairs Needed _____

LEAKS

How Serious _____

DATE: _____

County Engineer

TOWN ATHOL DAM NO. 02-06
LOCATION _____ STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by _____ Place SHARRETT DAM Use YES
Inspected by (signature) Date MARCH 10 69
Type of Dam _____ Condition GOOD

SPILLWAY

Flashboards in Place None 13-SCALE GATE OPEN
~~Recent Repairs~~ WATER WHEEL SHUT OF
Condition GOOD
Repairs Needed _____

EMBANKMENT

Recent Repairs _____
Condition _____
Repairs Needed _____

GATES

Recent Repairs _____
Condition GOOD 1 GATE OPEN (1 GATE CLOSED)
Repairs Needed _____

LEAKS

How Serious _____
DATE: _____ County Engineer _____

TOWN Attleboro DAM NO. 02-06
LOCATION Crescent St STREAM Millers River

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by L.S. Starnett Corporation Place Attleboro Use storage and mill pond
Inspected by W.C. Date Mar 27 1970
Type of Dam Earth and concrete Condition Good
Flood control

SPILLWAY

Flashboards in Place No flashboards Recent Repairs _____
Condition Good Minor conditions are very high but ok
Repairs Needed _____

EMBANKMENT

Recent Repairs _____
Condition Good
Repairs Needed _____

GATES

Recent Repairs Bascule Gate
Condition Good
Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ County Engineer

APPENDIX B-45

INSPECTION REPORT & DATA FOR DAMS

Owner: L S Starrett Co
 His Address: 165 Crescent St, Athol
 Function of Dam: water storage

Location & Access: Off Crescent St at Factory

USGS Quad. Athol Lat. 42° 35' 10" Long. 72° 13' 45"
 Drain. Ar. 19.6 Sq. Mi.; Ponds: 5.2 ac.; Res. @ dam: _____
 Character of D.A.: _____

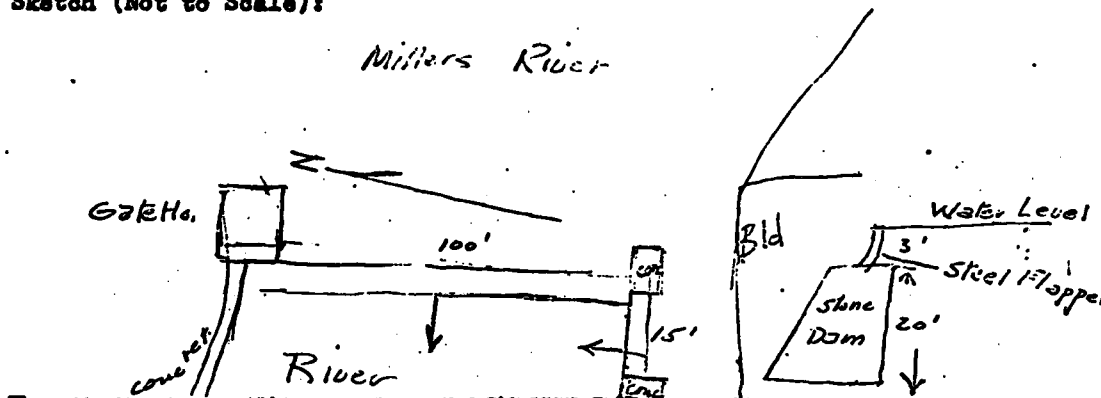
Dam No. 02-06
 Town: Athol
 Stream: Millers River
 Pond: _____
 Date: 1-7-72
 By: Edwin E. Cunn
 CONDITION RATING
 Structural: Good
 Hydraulic: 100 x 3 / 15 x 3
 General: Good
 PRIORITY: _____

Estimated
 Discharge: _____
 Capacity: _____

General Description of Dam and Discharge Control:

Stone & Concrete dam with a 3' high steel flap gate to control
flow. Gates in gatehouse also controls flow.

Sketch (Not to Scale):



Remarks and Recommendations:

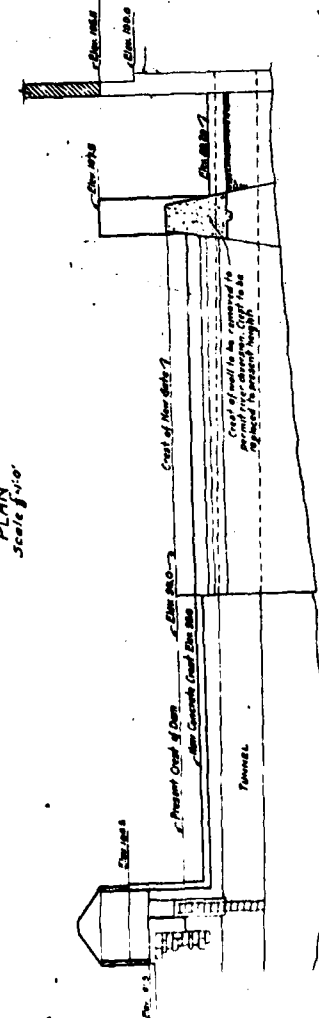
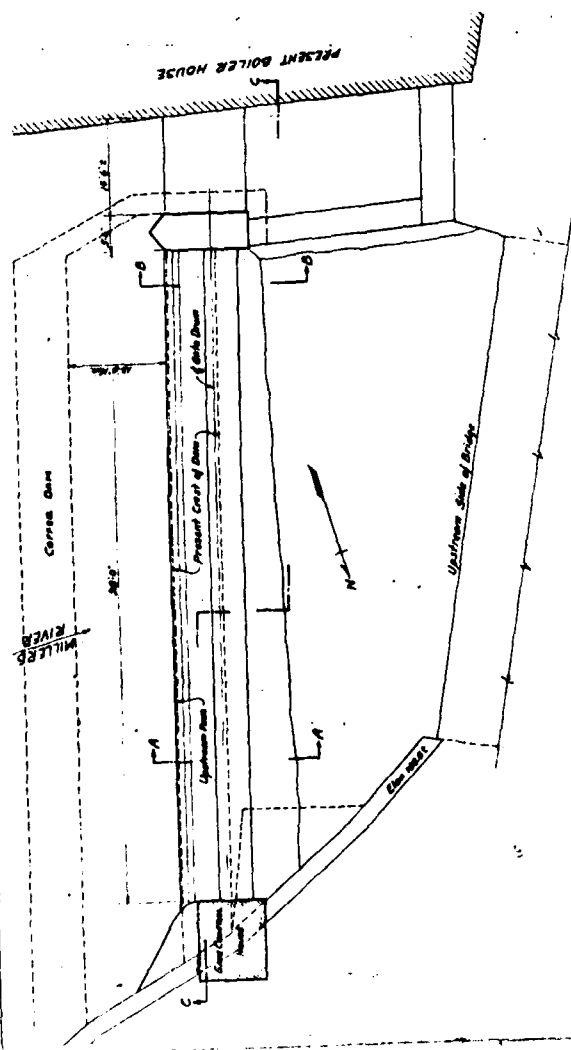
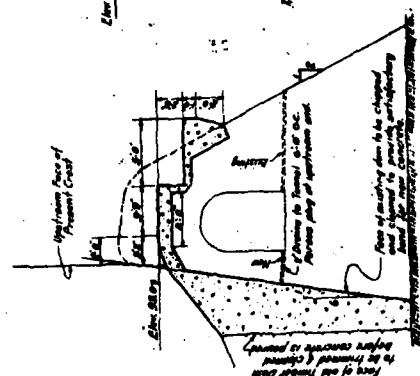
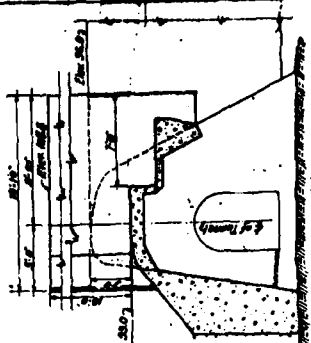
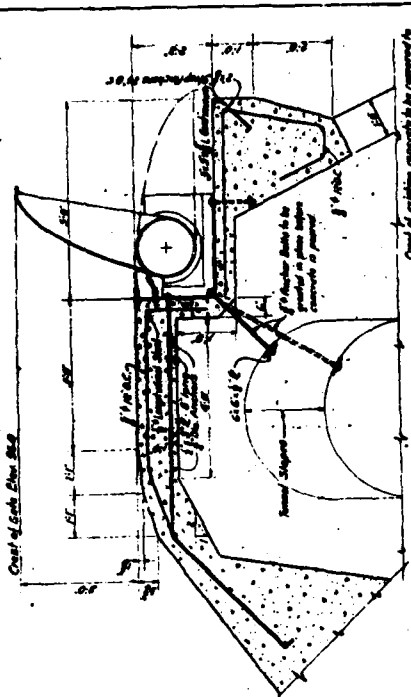
Dam & Gates in Excellent Condition.

Date 1-7-72

By Edwin E. Cunn Comment _____

Dam No. 3-14-15-06

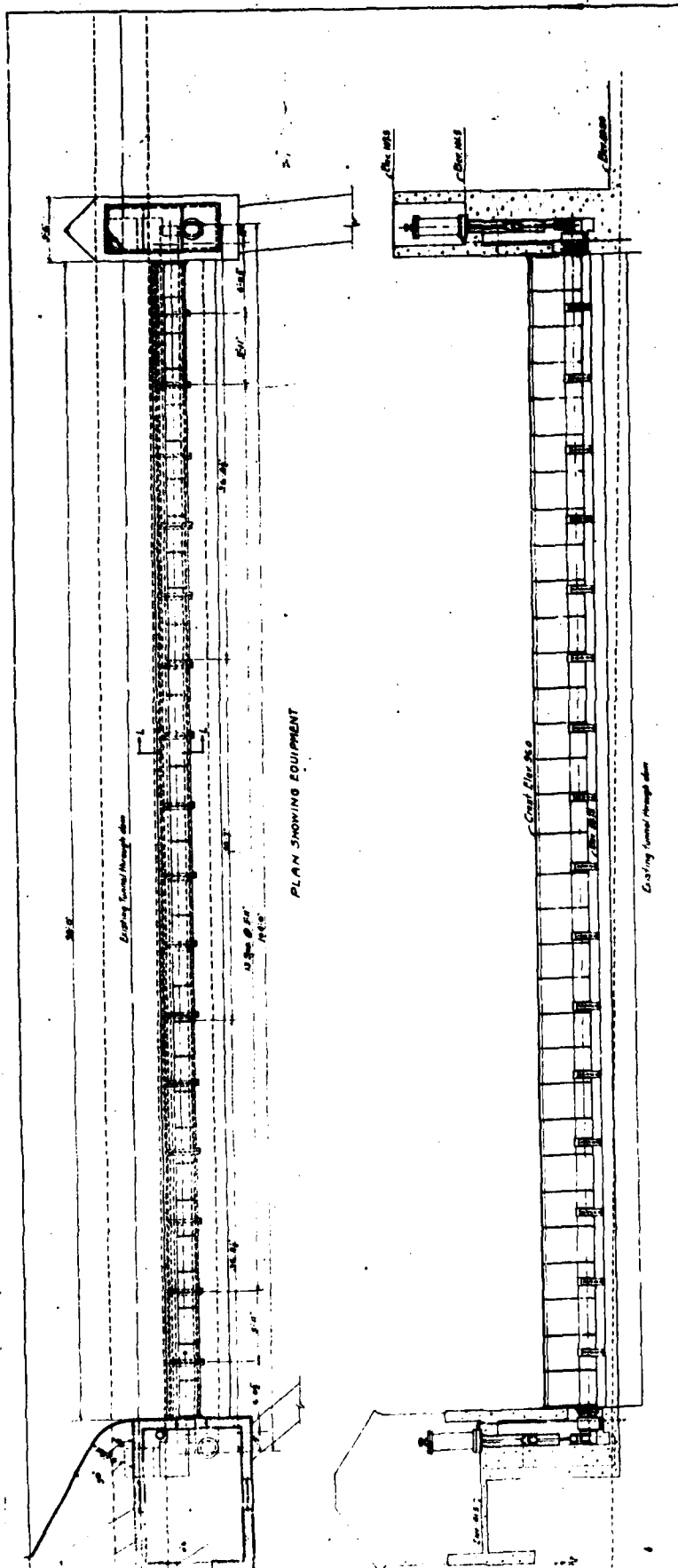
APPENDIX B-46



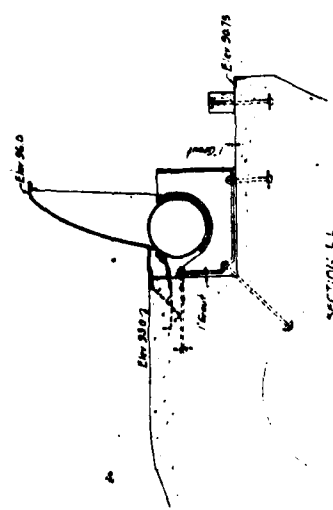
WORCESTER COUNTY COMMISSIONERS
 WORCESTER COUNTY BUSINESS DEPARTMENT
 PLAN OF
 CHEST CASTE SECTIONAL DETAILS
 ACROSS MILLERS RIVER
 ATHOL, MASS.
 FOR THE L. S. STARRETT CO.
 AS FILED AND APPROVED BY THE
 COUNTY COMMISSIONERS
 SCALED AS NOTED

[Handwritten signatures and stamps are visible over the document.]

L S STARRETT COMPANY
ATYOL, MASS
CREST GATE FOR DAM
CHAS T MAIN, INC., ENGINEERS
20 DEWING ST, BOSTON, MASS
160-141
FEB 14 1939



ELEVATION LOOKING UPSTREAM

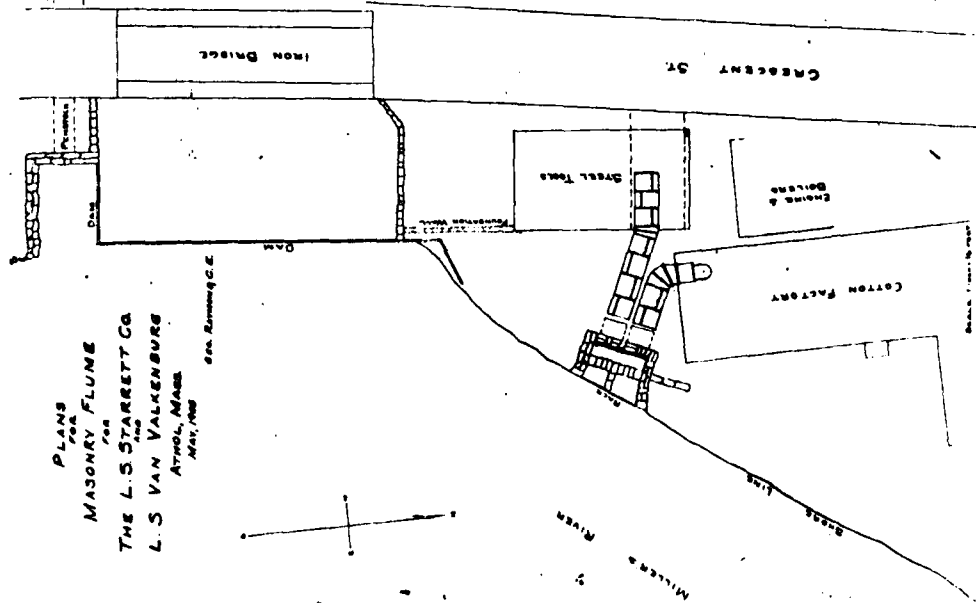


WORCESTER COUNTY COMMISSIONERS
 WORCESTER COUNTY ENGINEERING DEPARTMENT
 PLAN OF
 CREST GATE & ELEVATION OF DAM
 ACROSS WILKINS RIVER
 ATHOL, MASS.
 FOR THE L. S. STARRETT CO.
 AS ORDERED AND APPROVED BY THE
 COUNTY COMMISSIONERS
 DECEMBER 1918
 PREPARED BY
 L. S. STARRETT CO.
 100 North
 Street, Worcester
 MA 01602
 DRAWN BY
 George J. [Signature]
 CHECKED BY
 [Signature]
 DATE
 12-19-18

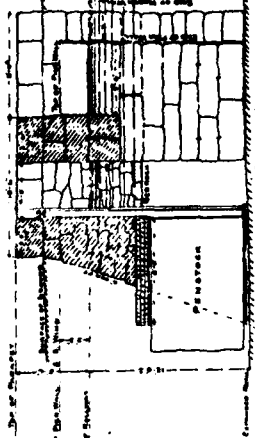
L. S. STARRETT COMPANY
 ATHOL, MASS.
 CREST GATE FOR DAM
 CHAS. T. MAIN, INC. ENGINEERS
 120 N. 12th
 W. 12th

PLANS
FOR
MASONRY FLUME
FOR
THE L.S. STARRETT CO.
AND
L.S. VAN VALKENBURG
ATHOL, MASS.
MAY, 1908

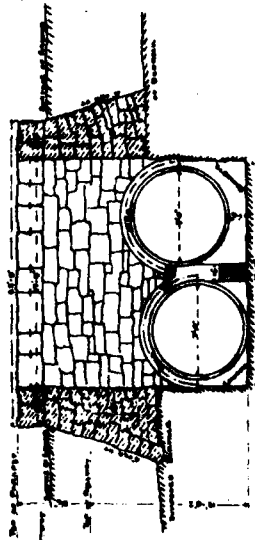
SEE RUNNING G.C.E.



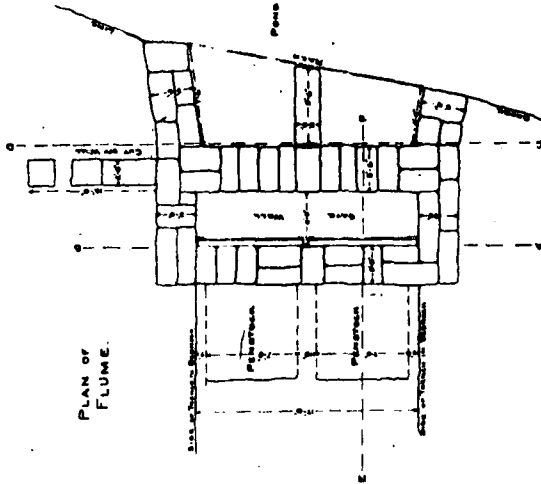
SECTION & ELEV. ON E-F



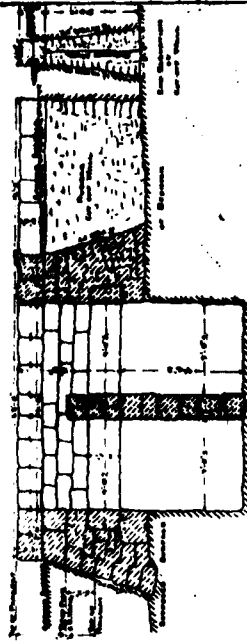
SECTION & ELEV. ON A-D



PLAN OF FLUME.



SECTION & ELEV. ON C-D



WORCESTER COUNTY COMMISSIONERS
WORCESTER COUNTY ENGINEERING DEPARTMENT
DAM
DESIGNED BY
L. S. STARRETT CO.
AS FILED AND APPROVED BY THE
COUNTY COMMISSIONERS
JUNE 12, 1908
MASS. COUNTY NO. 02-08
TRADES BY J. M. [illegible]
TRADING CHECKED BY [illegible]
COUNTY ENGINEER

*L. S. Starrett Co.
Engineers
Athol, Mass.
May 9, 1908*

APPENDIX C

SELECTED PHOTOGRAPHS OF PROJECT

LOCATION PLAN

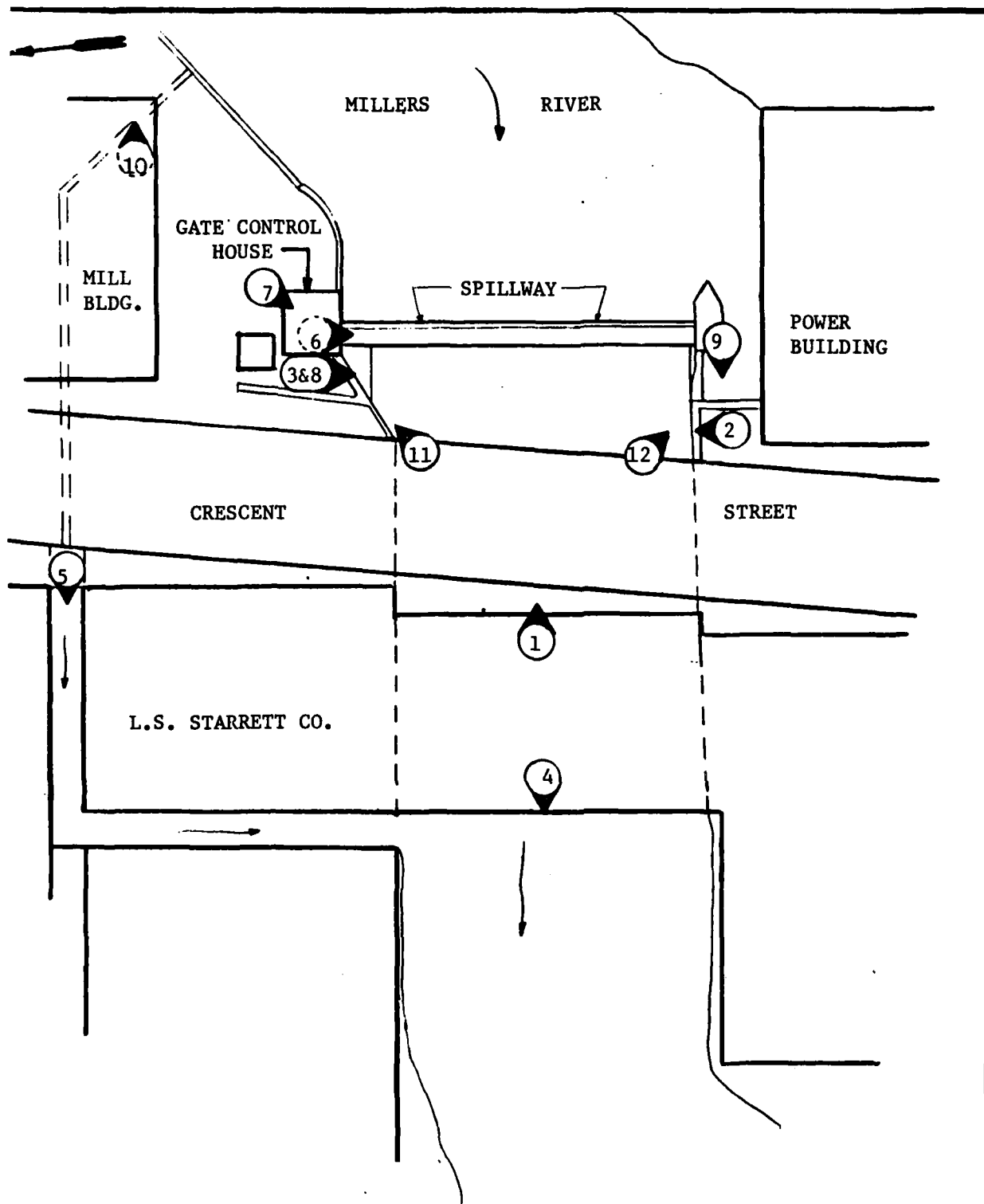
Location of Photographs

Page No.

C-1

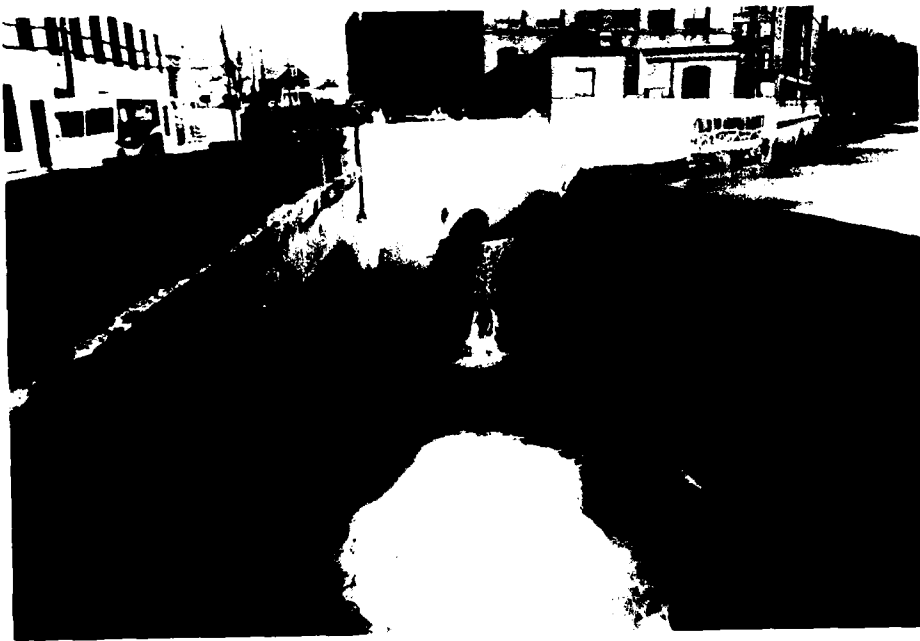
PHOTOGRAPHS

<u>No.</u>	<u>Title</u>	<u>Page No.</u>
1.	Overview of Dam From Roof of Building Which Spans Downstream Channel	iv
2.	View of Dam From Left Abutment	C-2
3.	View of Dam From Right Abutment	C-2
4.	Overview of Millers River Downstream of Dam From Right of Building Spanning River	C-3
5.	Overview of Outlet Works Discharge Channel	C-3
6.	Inspection and Pipe Gallery Within Dam Looking Towards Left Abutment	C-4
7.	Oil Pump, Air Compressor and Accumulator for Bascule Gate Housed in Right Abutment Gate House	C-4
8.	View From Right Abutment Showing Bascule Gate in Lowered Position	C-5
9.	Intake Channel and Screen for Turbine at Left Abutment	C-5
10.	Gate Operators for Outlet Works (foreground) and Right Abutment Turbine	C-6
11.	Gate House at Right Abutment	C-6
12.	Deterioration at Intersection of Intake Channel Wall and Bridge Abutment	C-7

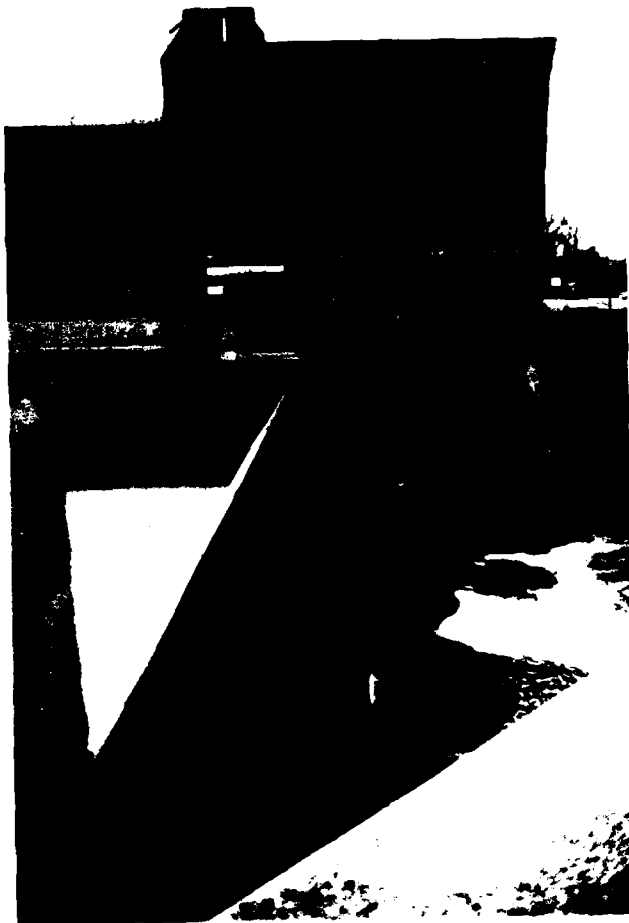


Note: (1) Denotes direction of view and photograph number.

National Program of Inspection
of Non-Federal Dams
Location of Photographs
Crescent Street Dam
Athol, Massachusetts



2. VIEW OF DAM FROM LEFT ABUTMENT.



3. VIEW OF DAM FROM RIGHT ABUTMENT. BASCULE GATE IN RAISED POSITION. AUXILLARY SPILLWAY, INTAKE CHANNEL AND CHANNEL DRAIN OUTLET IN BACKGROUND.



4. OVERVIEW OF MILLERS RIVER DOWNSTREAM OF DAM FROM ROOF OF BUILDING SPANNING RIVER.



5. OVERVIEW OF OUTLET WORKS DISCHARGE CHANNEL. MILLERS RIVER IS PARALLEL TO CHANNEL AND TO THE LEFT (NOT SHOWN IN PHOTO).



6. INPSECTION AND PIPE GALLERY WITHIN DAM LOOKING TOWARDS LEFT ABUTMENT.



7. OIL PUMP, AIR COMPRESSOR AND ACCUMULATOR FOR BASCULE GATE HOUSED IN RIGHT ABUTMENT GATE HOUSE (SHOWN IN PHOTO NO. 11).

AD-A155 786

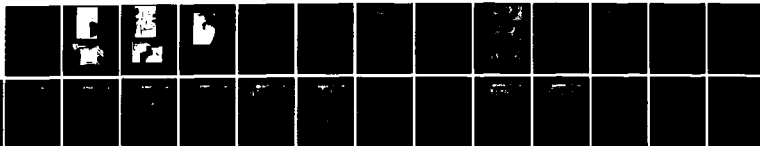
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
CRESCENT STREET DAM M. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV JUN 79

2/2

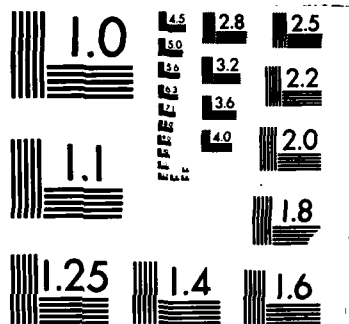
UNCLASSIFIED

F/G 13/13

NL



END



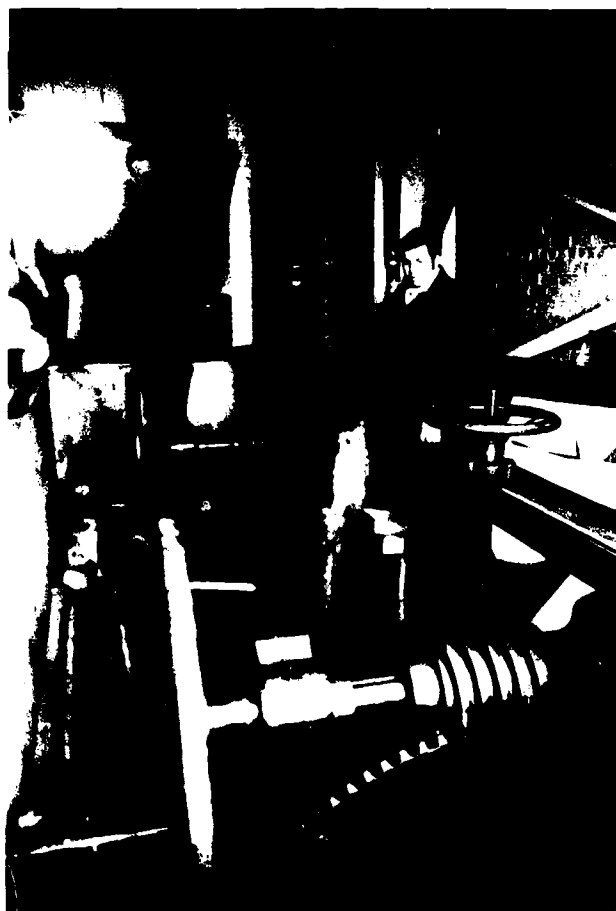
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



8. VIEW FROM RIGHT ABUTMENT SHOWING BASCULE GATE IN LOWERED POSITION.



9. INTAKE CHANNEL AND SCREEN FOR TURBINE AT LEFT ABUTMENT.



10. GATE OPERATORS FOR OUTLET WORKS (FOREGROUND) AND RIGHT ABUTMENT TURBINE



11. GATE HOUSE AT RIGHT ABUTMENT. NOTE PORTION OF CONTINUOUS CRACK IN RIGHT ABUTMENT WHICH PASSES THROUGH GATE HOUSE WALL (REPAIRED).



12. DETERIORATION AT INTERSECTION OF INTAKE CHANNEL
WALL AND BRIDGE ABUTMENT.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Page No.

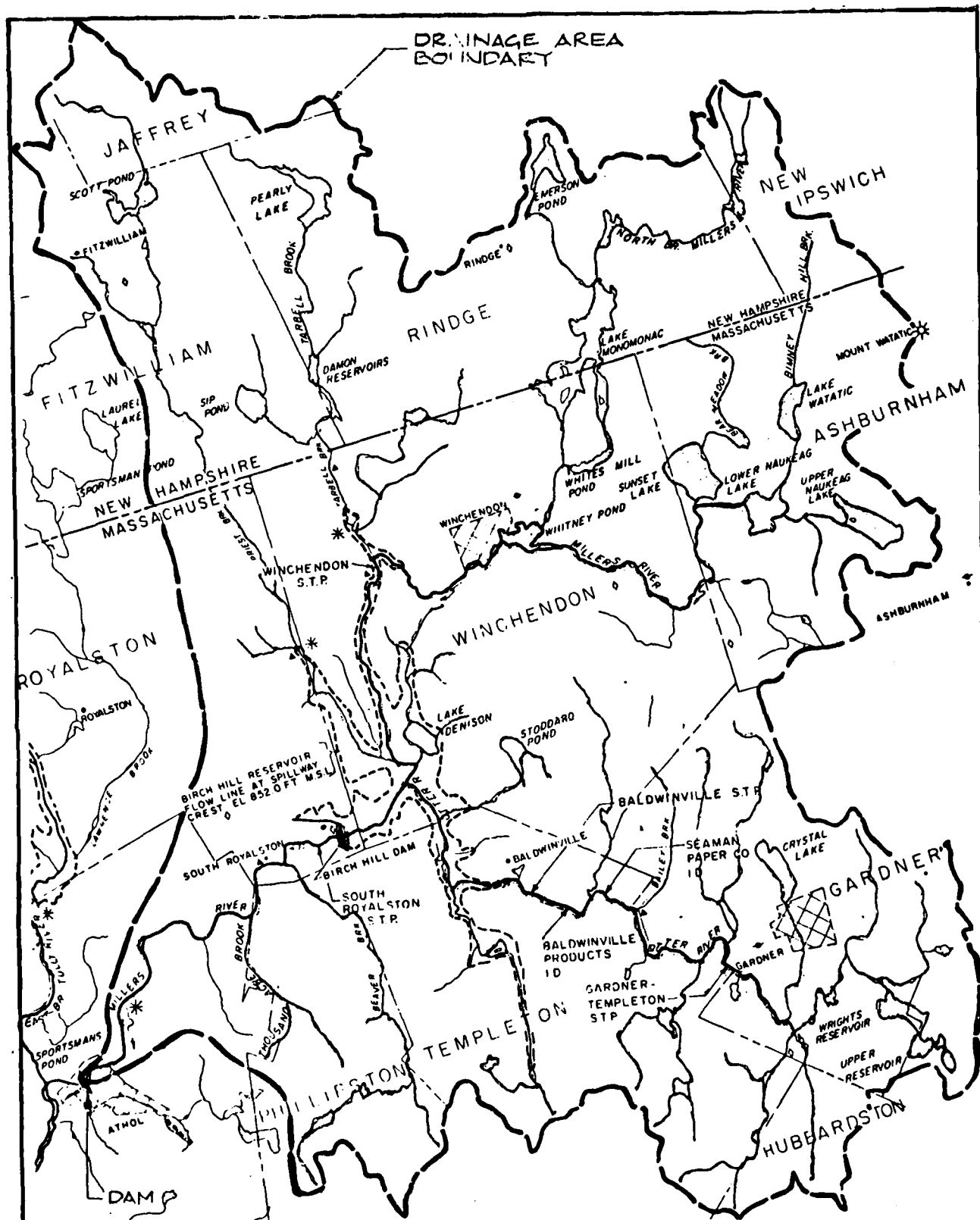
DRAINAGE AREA MAP

D-1

COMPUTATIONS

Size Classification, Hazard Potential & Test Flood
Dam Failure Analysis & Dam Failure Impact Area Map
Spillway Stage-Discharge Curve
Reservoir Area-Volume Curve
Stage-Discharge Curve-Crescent Street Bridge
Stage-Discharge Curve-Exchange Street Bridge
Flood Flows-Historic Storms
Flood Flows-Millers River
Channel Hydraulics-Millers River
Flood Profiles & Channel Conveyancy-Millers River
Flood Flows & Flood Routing-Birch Hill Dam
Flood Flows-Millers River at Crescent Street Dam

D-2
D-3 to D-5
D-6
D-7
D-8
D-9
D-10
D-11
D-12 & D-13
D-14 & D-15
D-16 to D-18
D-19 & D-20



DAM CRESCENT ST. DAM

IDENTIFICATION NO. MA 00934



DRAINAGE AREA MAP

APPROX. SCALE: 1" = 12,150'

Size Classification

Maximum hydraulic height = $549.3 - 521.1 = 28.2 \text{ ft.} < 40 \text{ ft.}$

Storage @ top of dam (El. 549.3) = $89.3 \text{ ac. ft.} < 1000 \text{ ac. ft.}$

Ref. Area-Volume Curve, Pg. D-6

∴ Size classification is SMALL

Hazard Potential

The dam failure analysis showed that the combined flood flow and flow due to massive structure failure of 90% of the dam length will approach 24,300 cfs, approximately 50% greater than the greatest flood flow to date. Because of the vulnerability of the L.S. Sturtevant mill complex just downstream of the bridge and dam, the hazard potential is considered to be HIGH.

Test Flood

The test flood for the foregoing combination is the $\frac{1}{2}$ PMF to the PMF. The $\frac{1}{2}$ PMF is adopted as the structure is essentially a masonry dam and not so susceptible to failure due to overtopping as an earth structure. The analysis considers both the routed $\frac{1}{2}$ PMF outflow from Birch Hill Reservoir as well as the developed $\frac{1}{2}$ PMF flow from the uncontrolled intervening drainage area. This results in a combined $\frac{1}{2}$ PMF flow of 26,900 cfs at the Cross Street Dam.

Dam Failure Analysis Since dam is concrete-masonry with spillway along its entire crest, type of failure is likely to be buckling or sliding, with more than 50% of length affected. However, we will adhere to Guideline expectation and use failure of 40% of length with pool at level of right bank wall (Elev 549.3). Note pool exceeded this level in Sept, 1933 (Elev. 553.8) and March, 1936 (Elev. 551.4) floods.

Dam Failure Flood Flow

$$Q_p = \frac{8}{27} W_b T_g Y_o^{\frac{3}{2}}$$

$$W_b = 98' \pm 10\% = 39.2 \text{ ft}$$

$$Y_o = 549.3 - 521.1 = 17.2 \text{ ft (Flow through failed portion of dam)}$$

$$\therefore Q_p = \left(\frac{8}{27}\right) (39.2') T_g (17.2)^{\frac{3}{2}} = 4,700 \text{ cfs}$$

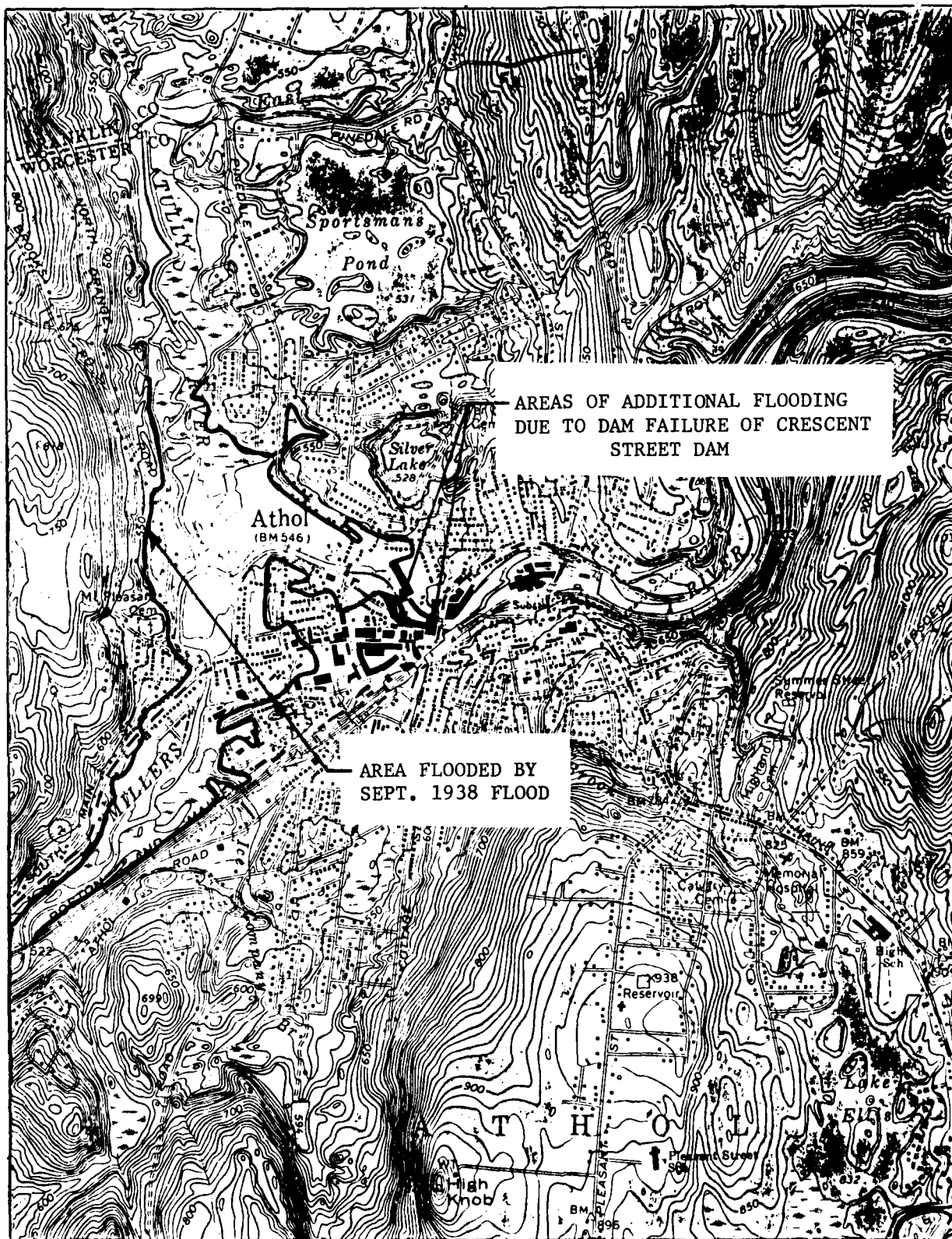
$$\begin{aligned} \text{Flood Flow at Failure (flow spillway taking curve)} &= 14,400 \text{ cfs} \\ &19,100 \text{ cfs} \\ \text{say } &\underline{19,100 \text{ cfs}} \end{aligned}$$

Sketches of recorded water levels at the Crescent and Exchange Street bridges as well as flood discharges at three gauging stations on the Millers River for the March, 1936 and September, 1933 floods enable the following estimates of flood flows at the Crescent Street Bridge.

March, 1936 - 11,000 cfs

September, 1933 - 16,000 cfs

The flood of March, 1936 destroyed the Crescent Street bridge while the September, 1933 flood washed away 100 ft. of the north approach to the Exchange Street bridge. Although the Crescent Street bridge was reconstructed, a movable crest installed on the Crescent Street dam, and the Exchange Street bridge reconstructed



DAM CRESCENT ST. DAM

IDENTIFICATION NO. MA 00934



DAM FAILURE IMPACT AREA MAP
USGS QUADRANGLE

ATHOL, MASS.

APPROX. SCALE: 1" = 2000'

with a higher deck elevation, channel emergency studies indicate that a flow of 24,300 cfs would very likely jeopardize the Crescent Street bridge as well as the L.S. Starnett road house building which spans the river immediately downstream. The failure of the dam would also cause flooding of the areas toward center the dam and any personnel working in the lower levels of the L.S. Starnett buildings would have their lives endangered from the rapid flooding. Channel emergency studies also indicate that the flood wall along the left bank of the river about 400 ft. downstream of Crescent Street would also be topped by this rate of flow with probable damage but less likely loss of life. However, because of hazard to employees working at L.S. Starnett complex, the hazard should be considered HIGH

Test Flood = $\frac{1}{2}$ PMF to PMF We will select the $\frac{1}{2}$ PMF
storm because of the risk to lives of
employees of L.S. Starnett Co.

Another Approach

Assume failure by massive rockfalls with 90% of dam length devastated
per stability analysis.

$$W_b = 98' \times 90\% = 88.2' ft.$$

$$Q_p = \left(\frac{2}{27} \right) (88.2')^3 g (28.2')^{\frac{3}{2}} = 22,207 \text{ cfs}$$

If 95% of dam length devastated, then

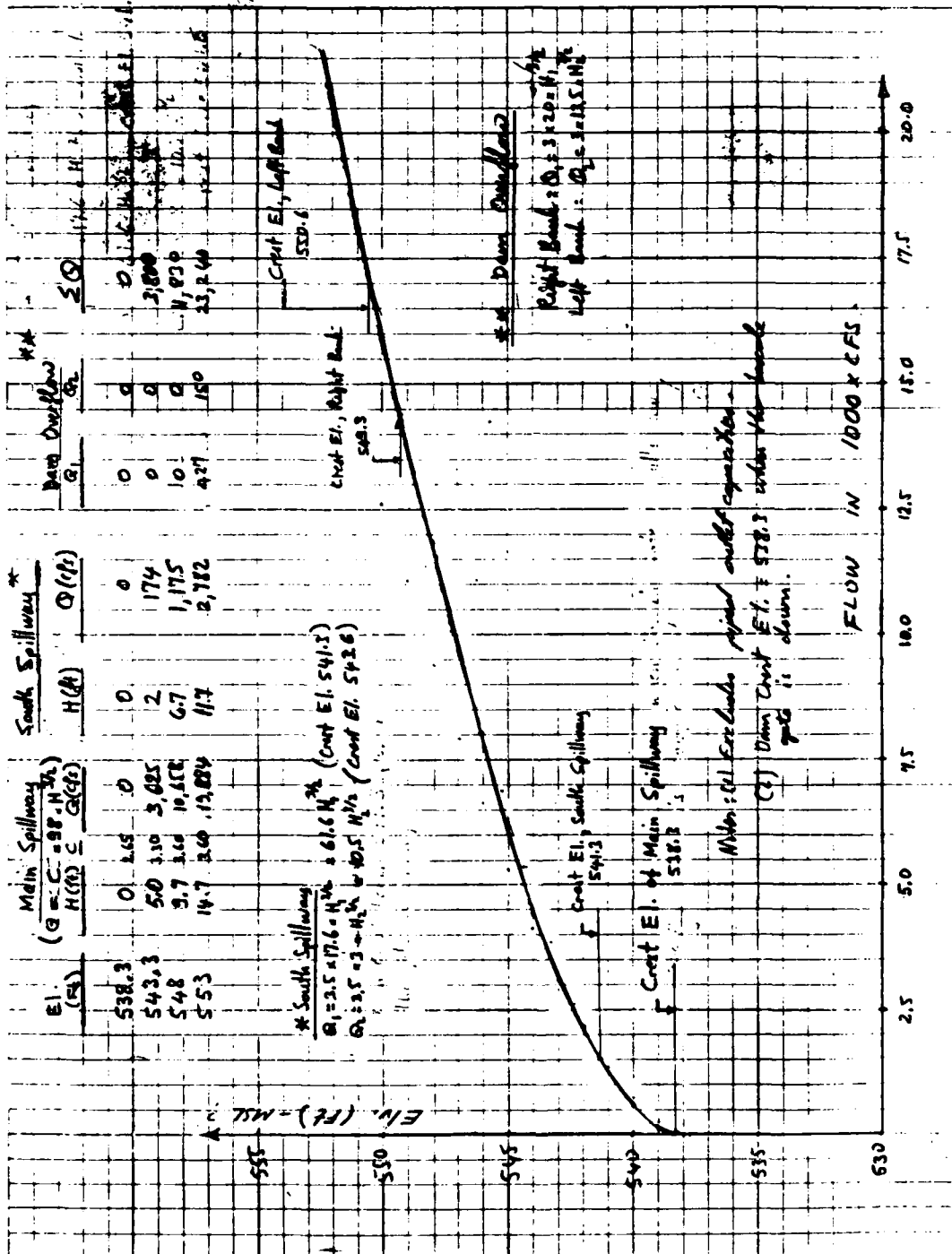
$$W_b = 98' \times 95\% = 93.1' ft.$$

$$Q_p = \left(\frac{2}{27} \right) (93.1')^3 g (28.2')^{\frac{3}{2}} = 23,441 \text{ cfs}$$

or consider failure with water level @ Sept, 1938 stage (El. 553.8) with 90% failure

$$Q_p = \left(\frac{2}{27} \right) (88.2')^3 g (32.7')^{\frac{3}{2}} = 27,730 \text{ cfs}$$

The average of above 3 for dam failure flow $\approx 24,500 \text{ cfs} \approx 24,300 \text{ cfs}$



CAMP DRENNER & MARINE INC.

CLIENT COE
PROJECT Dam Inspection
DETAIL Concord St. Dam

JOB NO 380-S-Rt-21

DATE CHECKED 5-3-79

CHECKED BY AWG

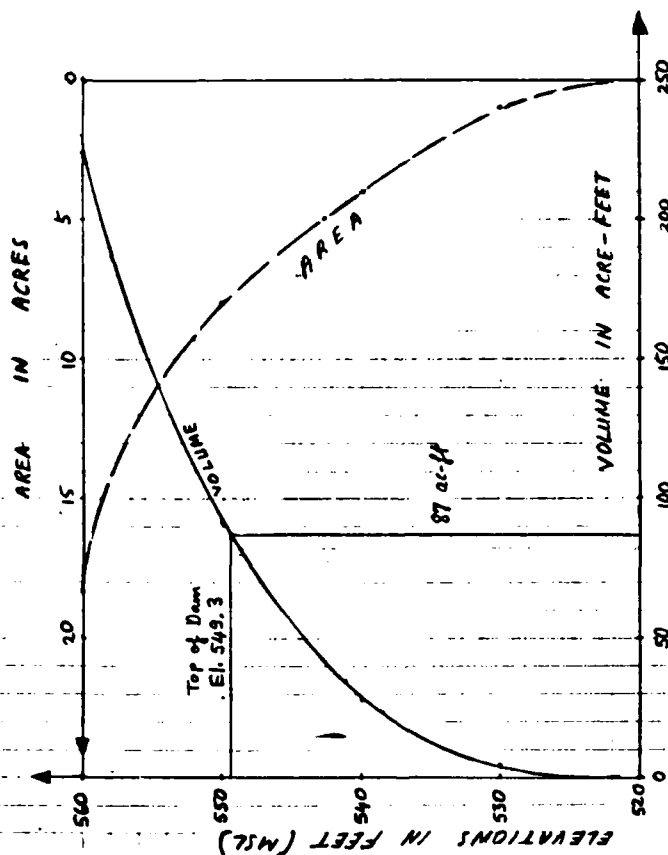
PAGE 6 of 79

DATE Feb. 23, 79

COMPUTED BY AWG

El. (ft) (MSL)	* W.S. Area (Acres)	d (ft)	Volume (ac-ft) Partial	Volume (ac-ft) Total
522	0	8	4	0
530	1	10	25	4
540	4	1.3	6	29
541.3	5	2.7	56	35
550	8	10	132	81
560	11.4			223

* Source USGS Atlat quadrangle
Pond acres under el. 54.3 were
estimated.



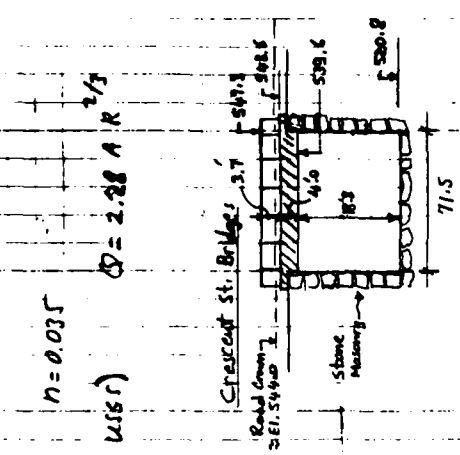
AREA - VOLUME CURVE

CAMP ENGINEER & ARCHITECT INC.

CLIENT COE
 PROJECT Dam Inspection
 DETAIL Crescent St. Dam

JOB NO 380-5-R1-21
 DATE CHECKED 5-5-88
 CHECKED BY Miller

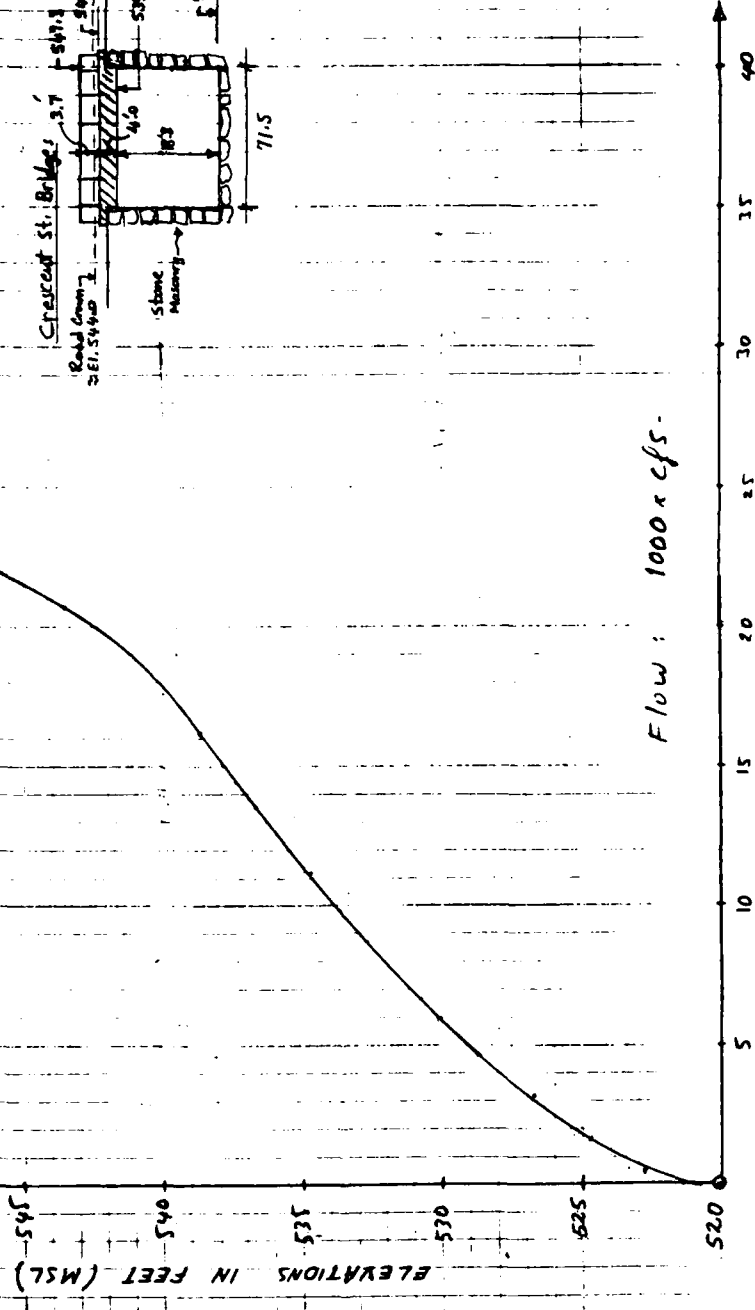
PAGE 7 of 19
 DATE 02/22/1979
 COMPUTED BY RLG



$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$$S = 0.0031 \text{ (from USB)}$$

$$Q = 2.28 A R^{2/3}$$



STAGE - DISCHARGE CURVE
 DOWNSTREAM CHANNEL AT CRESCENT ST. BRIDGE

4A	933	NED	MA	027	02	CRESCENT STREET DAM		4235.7	7213.6	27SEP74
----	-----	-----	----	-----	----	---------------------	--	--------	--------	---------

POPULAR NAME		NAME OF IMPOUNDMENT	
		MILLERS RIVER	
REGION/BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	DIST FROM DAM (MI.)
01 06	MILLERS RIVER	ATHOL	.0
POPULATION		11200	

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STATUS HEIGHT (FT.)	HYDRAU. HEIGHT (FT.)	IMPOUNDING CAPACITIES	
					MAXIMUM (ACRE-FT.)	NORMAL (ACRE-FT.)
PGOT	1900	C	37	31	160	85

DIST OWN FED R PRV/FED SCS A VER/DATE
NED

REMARKS
NO DPM NUMBER 21-STONE CONCRETE 22-24-26-27-ESTIMATED

D/S HAS	SPILLWAY TYPE	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	PROPOSED (MW)	NAVIGATION LOCKS			
						LENGTH (FT.)	WIDTH (FT.)	DEPTH (FT.)	LENGTH (FT.)
1	177	C	122						

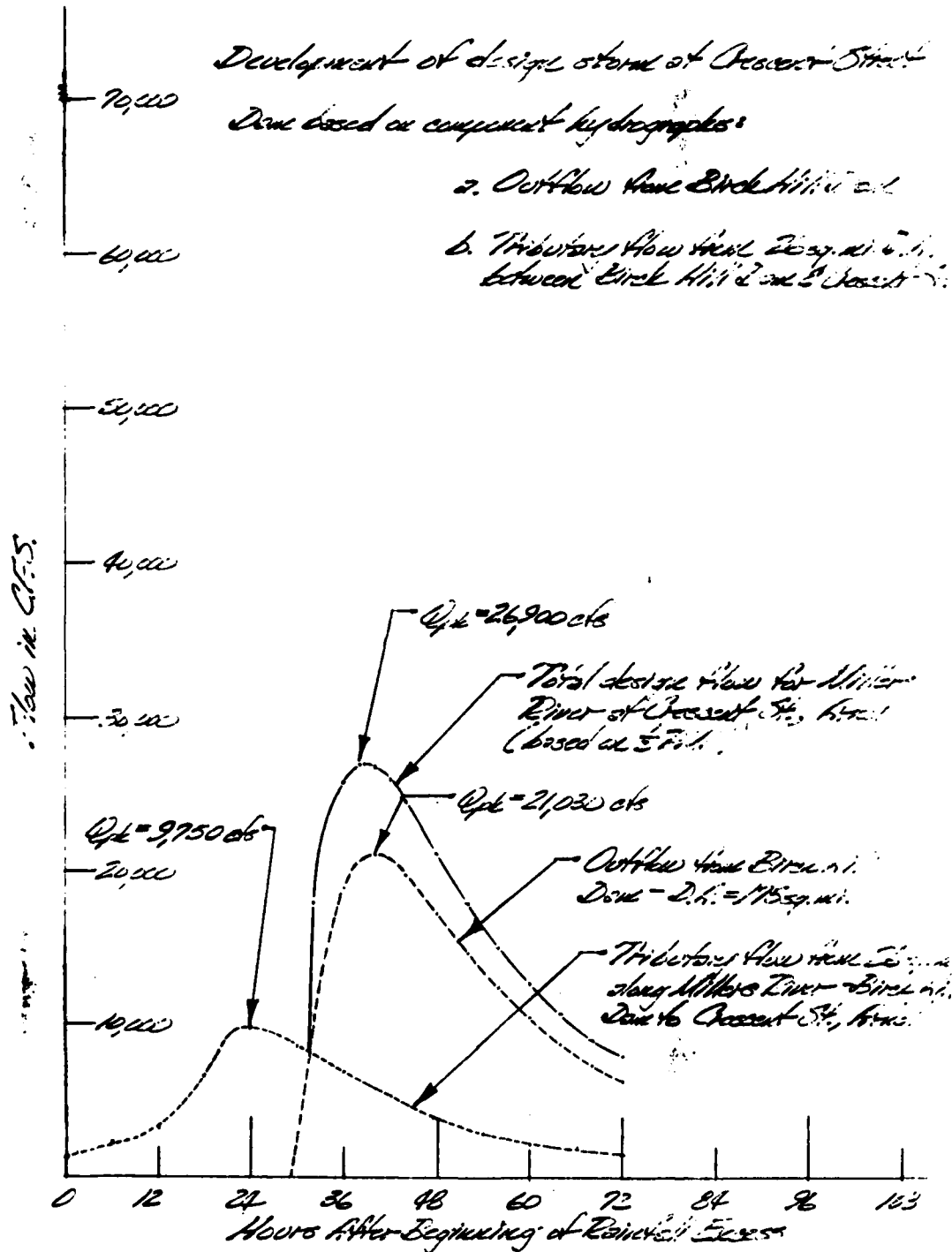
OWNER	ENGINEERING BY	CONSTRUCTION BY
L S STARRETT CO		

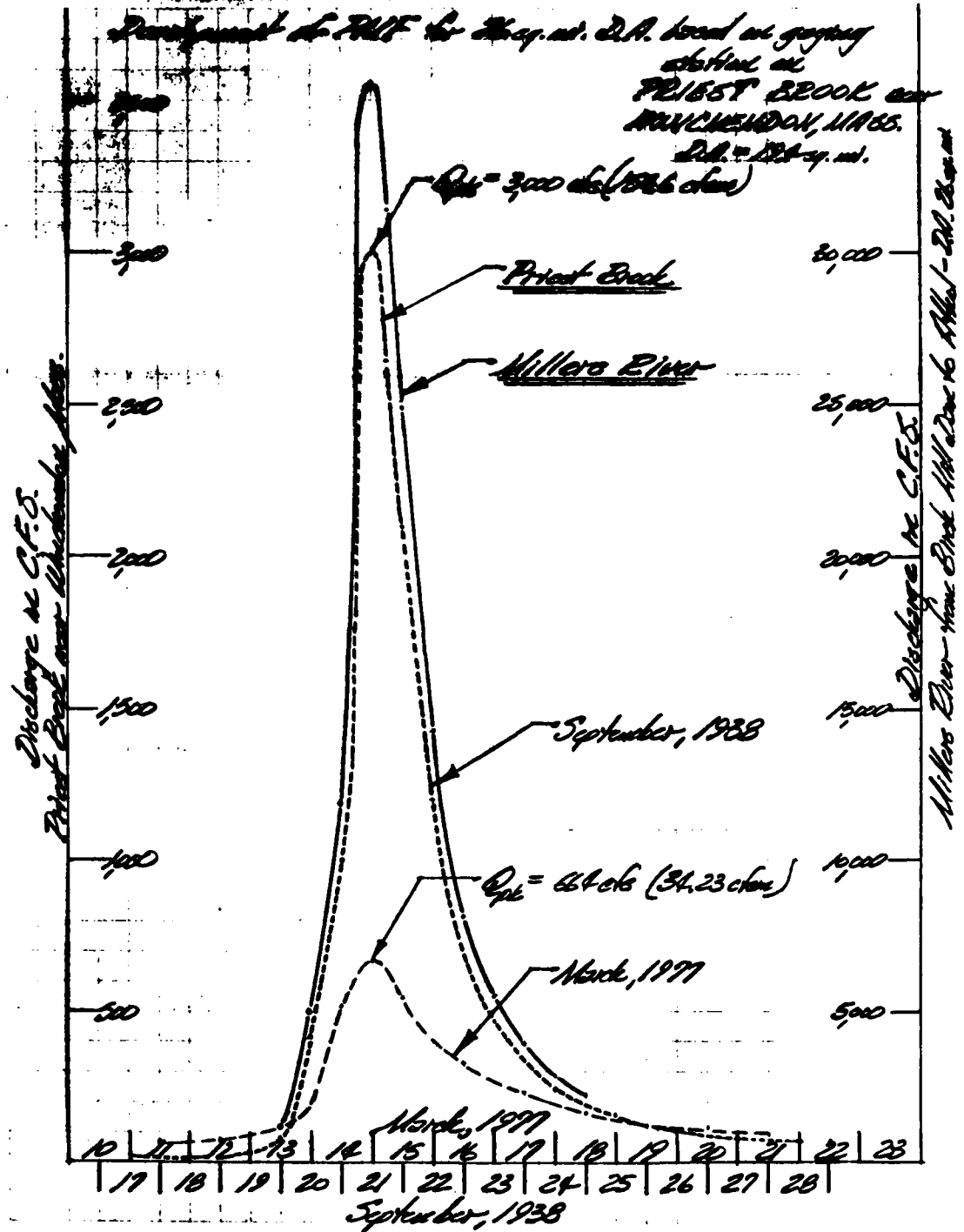
REGULATORY AGENCY	
DESIGN	CONSTRUCTION
OPERATION	MAINTENANCE

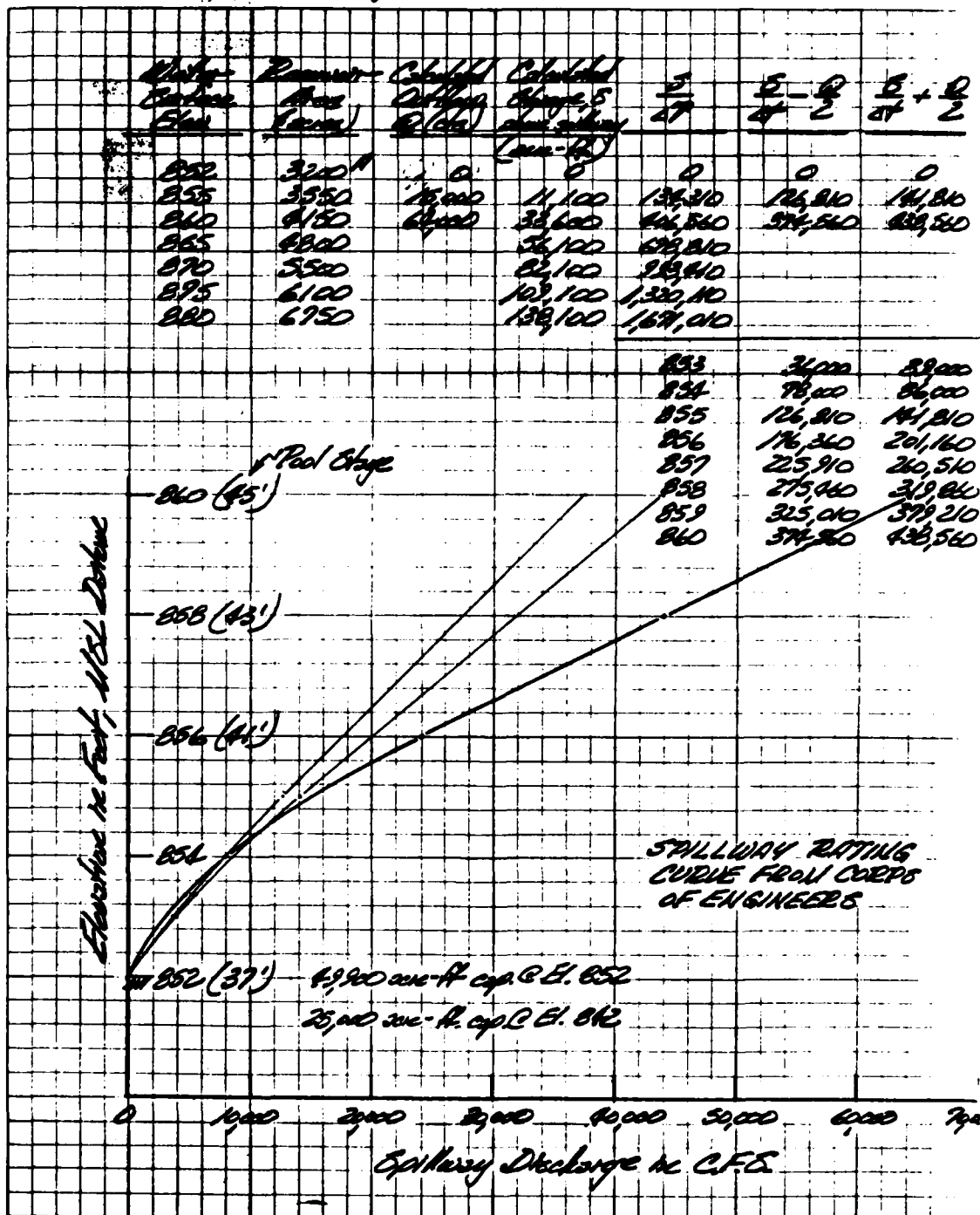
INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION

REMARKS

APPENDIX E
INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS







CAMP DRESSER & McKEE
Environmental Engineers
Boston, Mass.

CLIENT Camp Dresser & McKee
PROJECT Environmental Impact Statement
DETAIL Final Review

JOB NO 380-5-1
DATE CHECKED 7/23/79
CHECKED BY JED

PAGE 16 of 16
DATE 7/23/79
COMPUTED BY JED

Time No.	Observed Water (cfs)	Average Water (cfs)	S - Q AT 2 (cfs)	S + Q AT 2 (cfs)	Head above Spillway Gate (ft)	Water Surface Elev. (ft)	Q _v Cfs
0 (34)	38,000	38,500	0	38,500	1.00	853.00	2,950
1 (31)	35,900	36,950	35,900	72,939	1.92	853.72	6,500
2	33,750	34,915	66,239	101,054	2.27	854.27	9,900
3	32,080	33,510	91,166	124,076	2.68	854.68	12,700
4	30,450	31,270	111,300	143,570	3.01	855.01	15,000
5	28,700	29,550	129,415	157,035	3.36	855.36	17,500
6 (36)	26,925	27,910	139,513	167,323	3.45	855.45	18,500
7	25,500	26,210	148,110	174,320	3.55	855.55	19,500
8	24,100	24,900	153,950	178,752	3.62	855.62	20,500
9	22,780	23,440	159,652	181,020	3.66	855.66	20,900
10	21,450	22,120	159,606	181,726	3.67	855.67	21,200
11	20,200	20,820	160,135	180,955	3.66	855.66	21,400
12	18,940	19,570	159,491	179,061	3.63	855.63	21,600
13	17,950	18,500	159,910	176,340	3.59	855.59	20,800
14	16,900	17,410	155,638	173,048	3.53	855.53	19,700
15	15,950	16,420	153,930	168,310	3.46	855.46	19,100
16	15,000	15,400	149,769	165,349	3.39	855.39	18,500
17	14,160	14,580	146,379	160,959	3.32	855.32	17,800
18	13,320	13,740	143,797	156,537	3.25	855.25	17,300
19	12,610	12,965	139,105	152,070	3.17	855.17	16,500
20	11,900	12,260	135,376	147,636	3.10	855.10	15,800
21	11,250	11,580	131,674	143,254	3.02	855.02	15,100
22	10,600	10,920	128,016	138,936	2.95	854.95	14,500
23	10,080	10,310	124,296	134,656	2.87	854.87	14,000
24	9,585	9,840	120,536	130,376	2.80	854.80	13,600
25	9,070	9,330	116,810	126,140	2.72	854.72	13,000
26	8,550	8,810	113,105	121,915	2.64	854.64	12,400
27	8,100	8,320	109,411	117,731	2.57	854.57	11,900
28	7,650	7,880	105,751	113,631	2.50	854.50	11,500
29	7,320	7,480	102,165	109,645	2.42	854.42	10,900
30 (44)	6,980	7,150	98,680	105,830	2.36	854.36	10,500
31	6,640	6,800	95,343	102,163	2.29	854.29	10,000
32	6,350	6,505	92,134	99,641	2.23	854.23	9,610
33	6,050	6,200	89,055	96,365	2.17	854.17	9,190
34	5,760	5,905	86,094	93,289	2.11	854.11	8,770
35	5,480	5,620	83,217	90,267	2.05	854.05	8,350
36	5,210	5,345	80,507	87,252	2.00	854.00	8,000
37	4,960	5,085	77,868	84,253	1.94	853.94	7,700
38	4,735	4,850	75,277	81,277	1.88	853.88	7,400
39	4,535	4,635	72,752	78,387	1.82	853.82	7,100
40	4,360	4,450	70,303	74,753	1.76	853.76	6,800
41	4,220	4,290	67,950	72,200	1.71	853.71	6,500
42 (72)	4,080	4,150	65,668	69,818	1.66	853.66	6,300

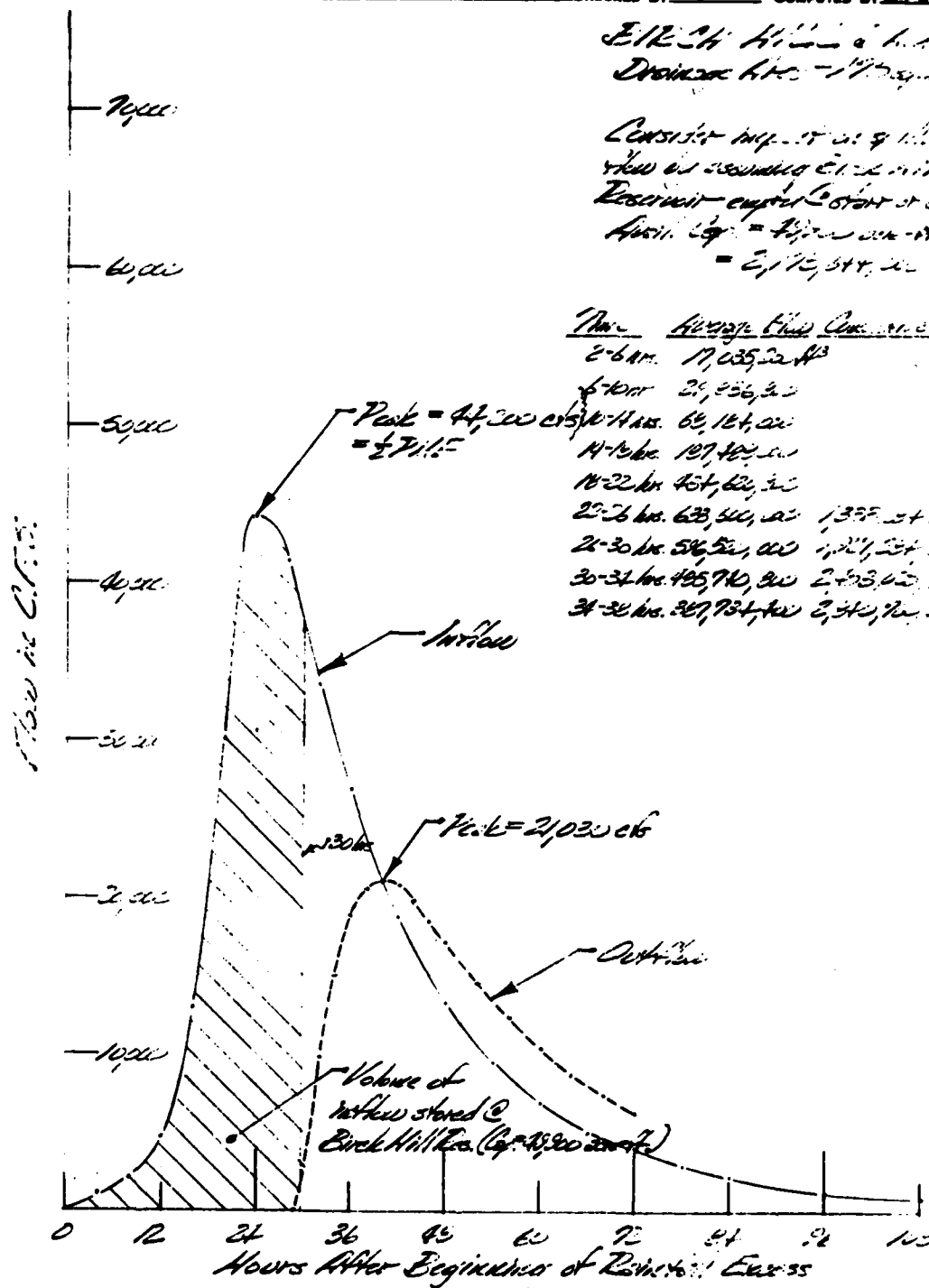
CAMP DRESSER & MCKEE
CONSULTING ENGINEERS
BOSTON, MASS.

CLIENT Copied & Engineering Division No. 3-2-5-1 PAGE 13 of 17
PROJECT Waterbury Station DATE CHECKED 3/23/79 DATE 1/26/79
DETAIL Peak Flow & Time CHECKED BY SED COMPUTED BY SED

BUCK HILL
Drainage Area - 17.7 sq. mi.

Consistent imp. of 8 in. 100 yr.
flow as recorded at B. Hill
Reservoir capacity 100,000 cu ft.
Avail. Cap. = 100,000 cu ft.
= 2,175,000 cu ft.

Time	Average Time	Com. in C.F.
2-6 AM	17,035,224	
6-10 AM	21,256,300	
10-12 PM	107,400,000	
12-2 PM	45,600,000	
2-6 PM	63,500,000	1,335,000 cu ft.
6-10 PM	56,500,000	1,211,000 cu ft.
10-12 PM	495,700,000	2,453,000 cu ft.
12-2 PM	307,700,000	2,540,000 cu ft.

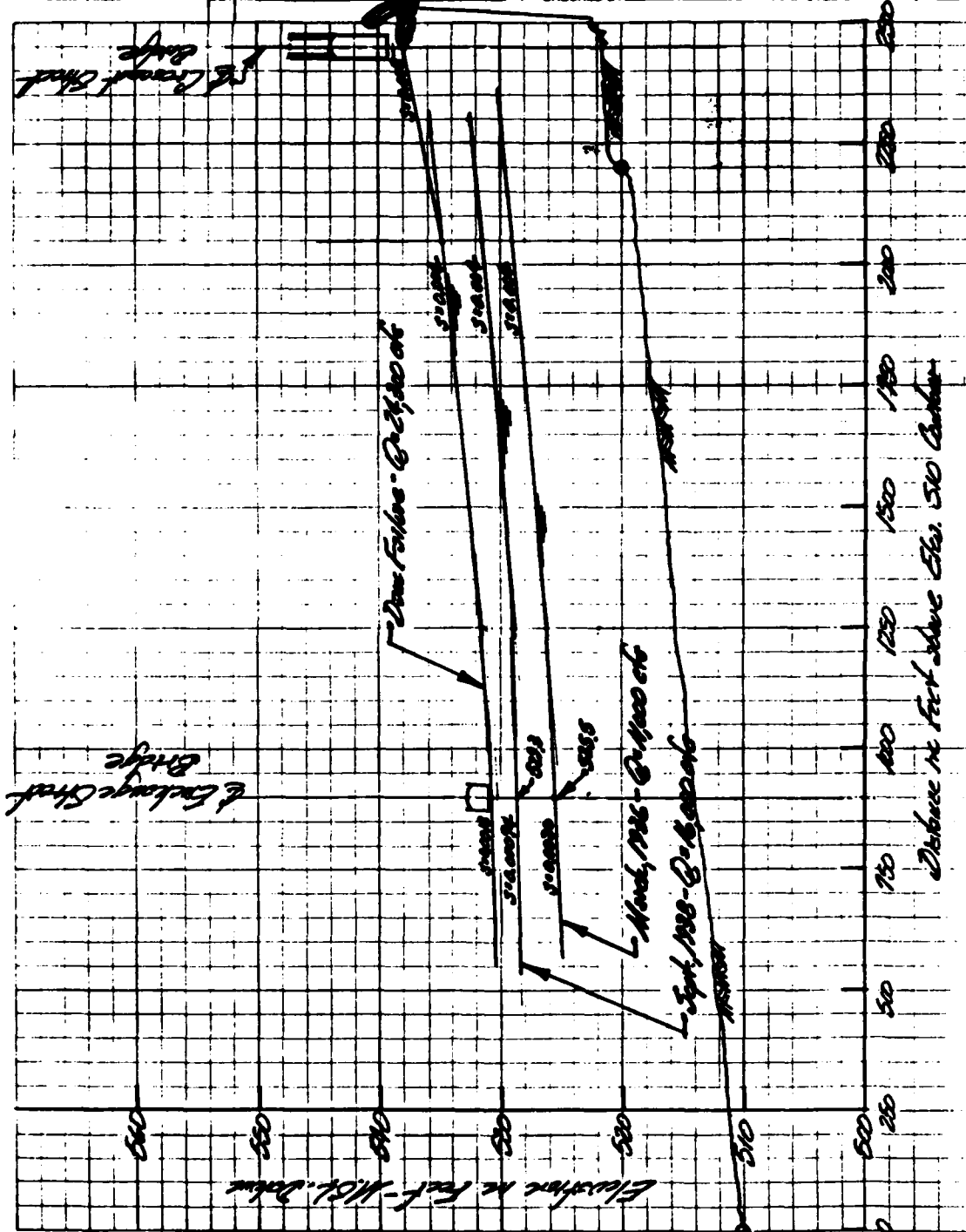


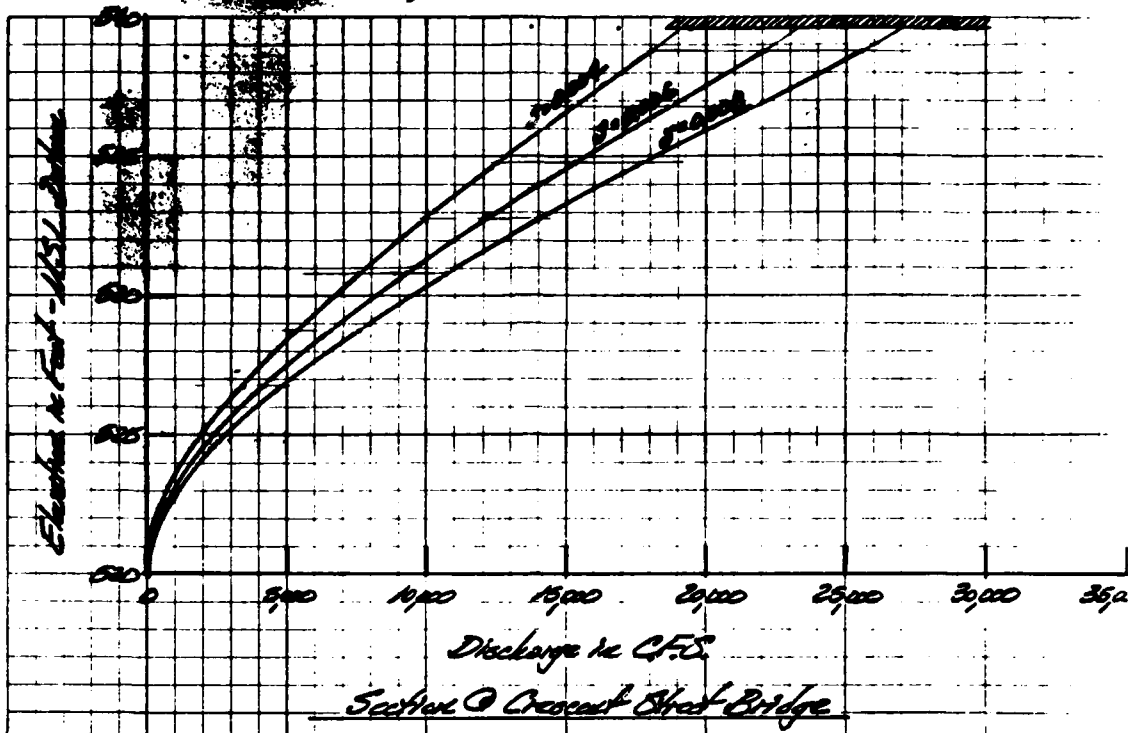
APPENDIX D-16

CAMP DRESSER & McKEE
Environmental Engineers
Boston, Mass.

CLIENT Coastal Engineers - Danvers JOB NO. 80-5-21
PROJECT Coastal Erosion Study DATE CHECKED 6-8-79
DETAIL Reduction of Erosion CHECKED BY h.e. d.

PAGE 16 of 19
DATE 6-8-79
COMPUTED BY h.e. d.





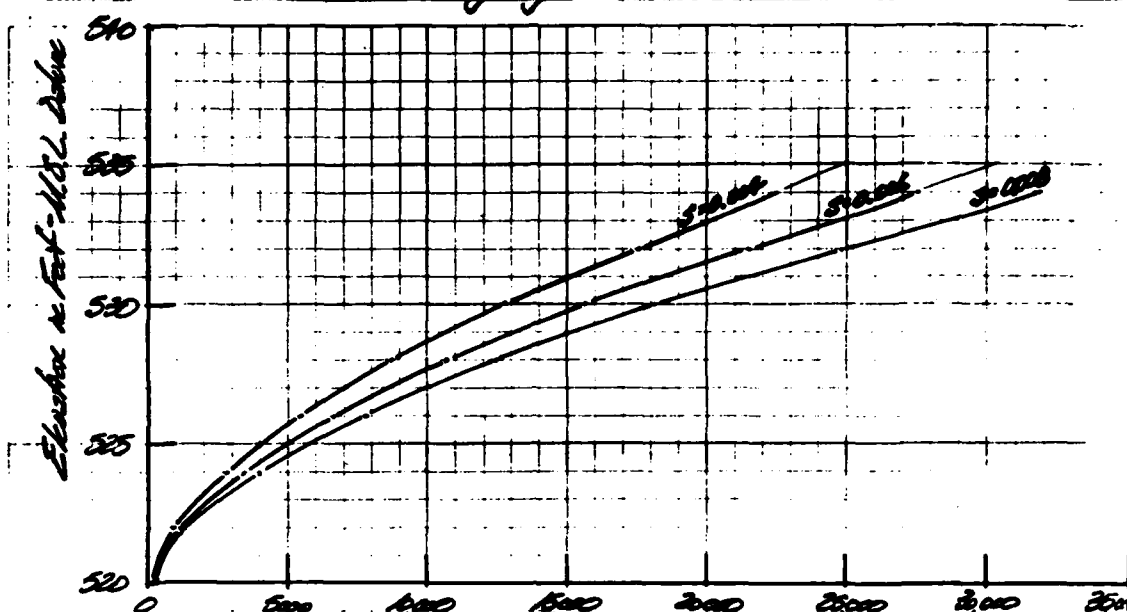
Depth	W.S. Elev.	Area	R	R^3	S_1	Q_1	S_2	Q_2	S_3	Q_3
2'	522.8	143	1.094	1.3008	0.002	587.0	0.006	920.6	0.008	881.3
4'	524.8	206	3.597	23498	$T = 0.0032$		$T = 0.0115$		$T = 0.0294$	
6'	526.8	429	6.137	29795		1803.1		2200		2550
8'	528.8	672	6.537	34962		3430		4201		4851
10'	530.8	915	7.814	39370		5390		6577		7594
12'	532.8	1158	8.984	43217		7560		9260		10622
14'	534.8	1401	10.060	46602		9951		12135		14001
16'	536.8	1644	11.053	49620		12326		15341		17915
18'	538.8	1887	11.972	52334		15243		18669		21357
20'	540.8	2130	12.812	54821		18086		22151		25597
22'	542.8	2373	13.543	57021		20960		25852		29459

CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass.

CLIENT City of Boston, Dept. of Public Works
PROJECT Channel Deepening
DETAIL Channel Deepening

JOB NO. 300-5-21
DATE CHECKED 6-8-79
CHECKED BY Jac. R.

PAGE 12 of 19
DATE May 8, 1979
COMPUTED BY W. J. R.



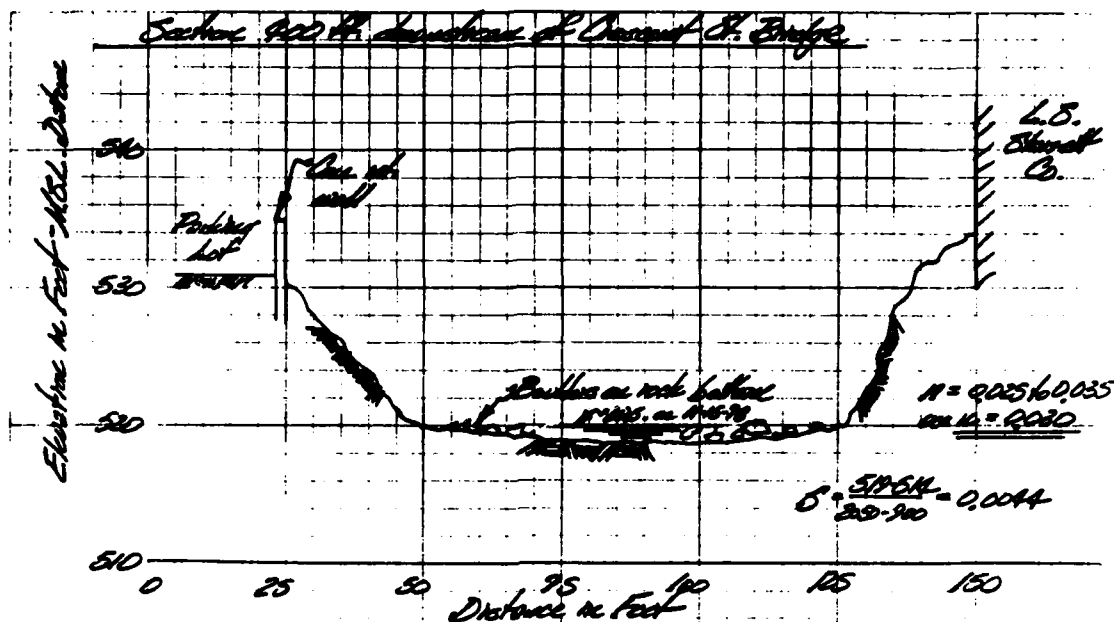
Discharge in C.F.S.

Section 400 ft downstream of Arsenal St. Bridge

CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass.

CLIENT City of Cambridge JOB NO. 320-5-21
PROJECT Cambridge River DATE CHECKED 6-8-79
DETAIL Channel Hydrology CHECKED BY Lee H.

PAGE 11 of 19
DATE 11/16/1971
COMPUTED BY W.H.



$$Q = \frac{1.486}{0.030} A R^{2/3} S^{1/2} = 42.533 A R^{2/3} S^{1/2}$$

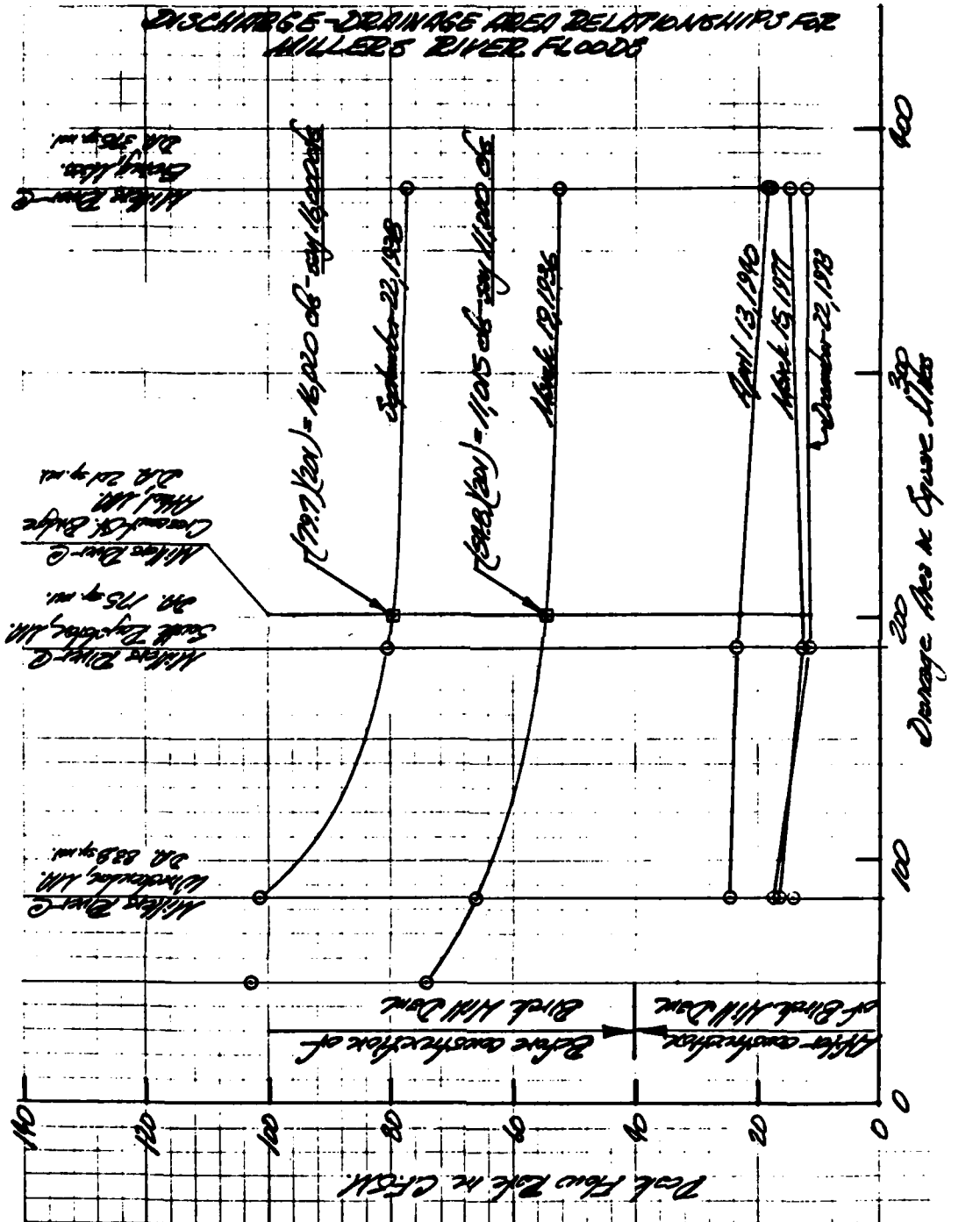
W.S. Elev.	Area	R	$R^{2/3}$	S	Q_1	S_2	Q_2	S_3	Q_3
520	18.75	0.25	0.3163	0.004	1734	0.006	22.4	0.008	246
				$T = (0.0032)$		$T = (0.0073)$		$T = (0.0084)$	
522	179	2.06	1.6227		916		112		1295
524	356	4.07	2.501		2828		3457		3992
526	546	5.91	3.195		5465		6693		7729
528	749	7.33	3.783		8773		10745		12407
530	965	8.70	4.233		12787		15672		18088
532	1191	10.23	4.713		17585		21537		24969
534	1421	12.15	5.021		22508		27567		31831

CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass.

CLIENT City of Cambridge - Dept. of Public Works
PROJECT Cambridge Flood Control Study
DETAIL Flood Flow - Miller River

JOB NO. 380-5-21
DATE CHECKED 6-8-79
CHECKED BY Joc A.

PAGE 19 of 19
DATE Aug 8, 1979
COMPUTED BY Miller



CAMP DRENNER & MAYER INC.

CLIENT

COE

JOB NO

380-S-M-21

PAGE

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PROJECT

Down Exchange

DATE CHECKED

8-29

DATE

Feb 23, 79

DETAIL

Channel at Exchange St. Bridge

CHECKED BY

AWK

COMPUTED BY

AWK

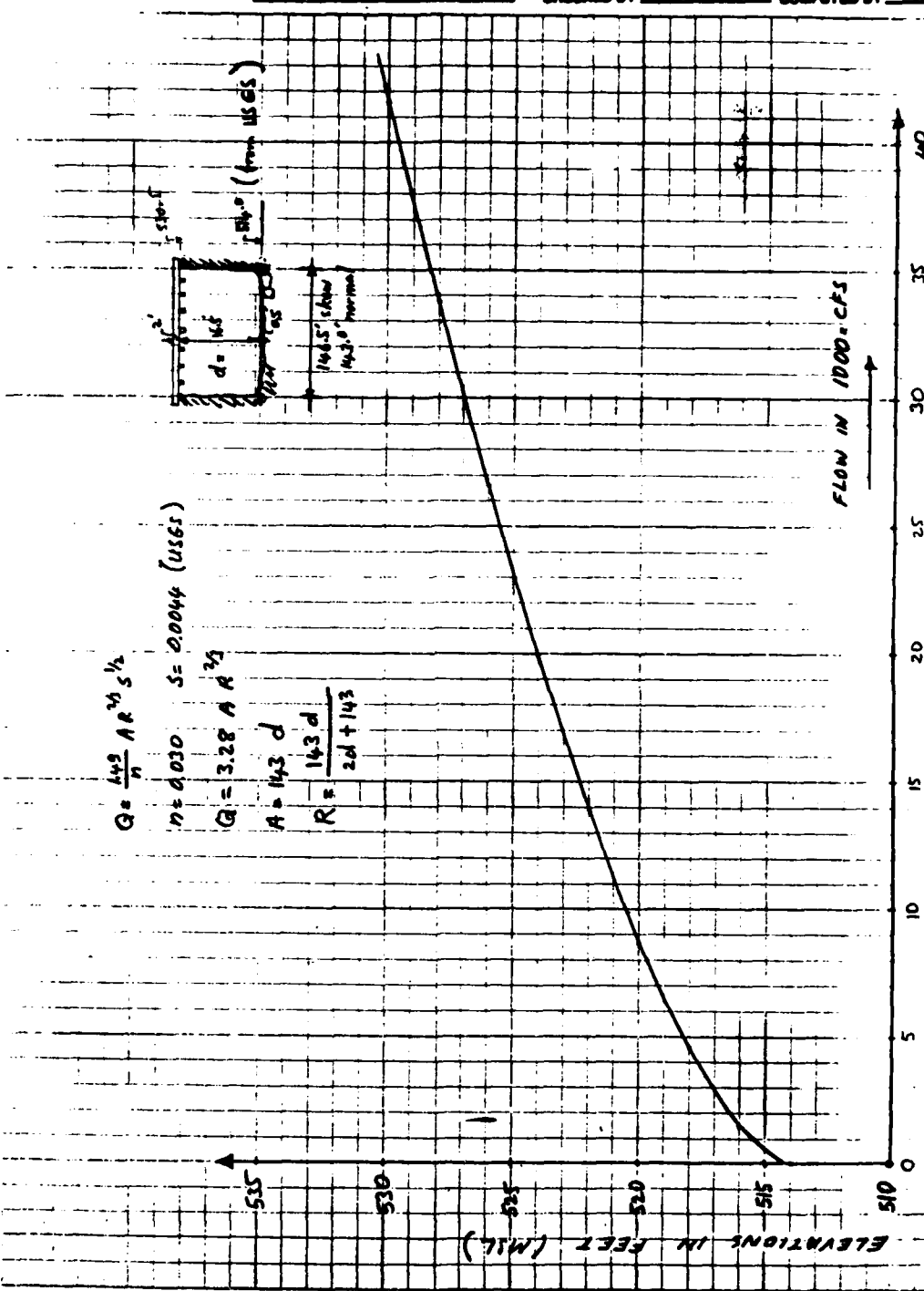
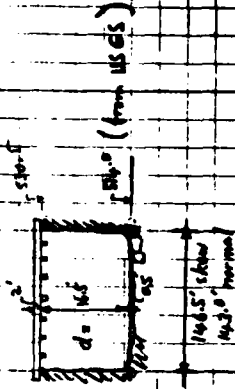
$$Q = \frac{149}{n} A R^{2/3} S^{1/2}$$

$$n = 0.030 \quad S = 0.0044 \text{ (USGS)}$$

$$Q = 3.28 A R^{2/3}$$

$$A = 143 d$$

$$R = \frac{143 d}{2d + 143}$$



STAGE-DISCHARGE CURVE
DOWNSTREAM CHANNEL AT EXCHANGE ST. BRIDGE

APPENDIX D-9

END

FILMED

8-85

DTIC